Kathmandu University Medical Journal (2005) Vol. 3, No. 2, Issue 10, 123-129

Original Article

A study of sensitivity and resistance of pathogenic micro organisms causing UTI in Kathmandu valley

Jha N[1], Bapat S K[2]
[1]Lecturer, [2]Professor and Head, Department of Pharmacology, Kathmandu Medical College, Kathmandu

Abstract
A retrospective study was conducted in five hospitals to observe the prevalence of organisms causing UTI and their sensitivity to antibiotics. **Methodology:** Altogether, data from five hundred samples of urine from five hospitals in Kathmandu was collected for this study from January 2005 to April 2005. **Result:** A total of 244 samples were found to be positive. Altogether six types of organisms were isolated as the causative factors. E. coli (49%), S. aureus, (coagulase positive) (23%), Proteus species (3.6%), Klebsiella (9.71%), Pseudomonas (0.8%) and Citrobacter (2.8%). Analysis of the samples showed that UTI was more common in females of younger age group as compared to males. The common age group for females was 21-30 years, whereas that for males was 31-40 years in all the hospitals except in hospital A, where the maximum number of females was from 31-40 years and males were between 71-80 years. The most common organism to cause UTI was found to be E. coli (49%), followed by S. aureus (23%) and Klebsiella (9.71%). All the organisms causing UTI were sensitive to nitrofurantoin and amoxycillin and ciprofloxacin was found to be least effective. Similarly, in three hospitals, B (88.2%), D (64.7%) and E (65.3%), amoxycillin was found to be most effective, amikacin and gentamycin (92.5%) was most effective in hospital C, and nitrofurantoin in hospital A (78%). The second commonest organism, i.e., S. aureus (23%) was most sensitive to cephalosporin (88.8%) of second generation, followed by nitrofurantoin (77.7%), amikacin (80.6%) and norfloxacin (65.5%). The third common organism, Klebsiella (9.71%) was most sensitive to norfloxacin (75%) and nitrofurantoin (75%). Lastly, Pseudomonas was resistant to all the antibiotics in hospital A, D and E, nil in hospital B and sensitive to amikacin (100%) in hospital C.

Keywords: UTI, common pathogens, antibiotics sensitivity, resistance profile

Urinary tract infection (UTI) is one of the commonest domiciliary and nosocomial bacterial infections,[1] comprising of a variety of clinical conditions caused by microbial invasion of tissue lining the urinary tract which extends from renal cortex to urethral maetus. Infection of adjacent structures such as prostrate and epididymis is also included in this entity. It also refers to the presence of bacteria undergoing multiplication in urine within the urinary drainage system[2] and presence of more than 10^5 organisms per ml. in the mid stream sample of urine.

Infection of urinary tract is amongst the most common bacterial infections that prompt patients to seek medical advice second only to infection of respiratory tract. It has been estimated that about six million patients visit out patient departments and about 300,000 are treated in the wards every year for UTI [3] worldwide. Approximately, 10% of human population get UTI at some stage during their lives. Nepal, being a developing country, has about 61.4% illiterate people [4] who do not have any concept of hygiene and so are always vulnerable to infections by various organisms. According to the annual report of fiscal year (2055/2056) published by Department of health services, 0.46% of total outdoor patients suffered from UTI and this was out of the total population of Nepal (2, 22, 87,417)[4].

E. coli is present in 80-90% of UTI [5] whereas in about 95% of patients suffering from acute pyelonephritis, the infecting organisms are gram-negative rods, Proteus mirabilis and Klebsiella pneumoniae. Gram-positive organisms found are Streptococcus agalacticus and coagulase negative Staphylococci [6].

The geographical distribution of UTI amongst the Nepalese population is 0.57% in the mountains, 0.45 % is estimated to be in planes.[7].

Correspondence
Nisha Jha,
Lecturer, Department of Pharmacology
Kathmandu Medical College
E-mail: nisha_venus@hotmail.com

Resistance to antibiotics is highly prevalent in bacterial isolates all over the world, particularly in developing countries [8, 9, 10, 11, 12]. In many parts of Nepal, the facilities for culture of urine and testing of sensitivity to antimicrobials are not available thus leading to incorrect diagnosis and management of UTI [13].

This study was undertaken to observe the current trend of sensitivity and resistance profile of organisms causing UTI in five hospitals of Kathmandu valley.

Methodology

Five hospitals, Kathmandu Medical College Teaching Hospital, Sinamangal (A), Tribhuwan University Teaching Hospital, Maharajgunj (B), Shukraraj Hospital for Tropical and Infectious Diseases, Teku (C), Medicare National Hospital and Research Centre (D), Chabahil, and Central laboratory, Teku (E) were chosen. Samples from patients clinically suspected of UTI attending out patient department and hospitalized patients of each hospital were collected. The study was retrospective and analytical study, with one hundred samples from each hospital. Data regarding antibiotic sensitivity profile of microorganisms isolated in the various clinical cases in the laboratories of the above hospitals above were collected in a structured format with the consent of the laboratory personnel. This included all the information about patients along with our study variables and demographic profiles.

Samples were cultured in blood agar and MacConkey agar plate and incubated for 24hrs at 37^0C. Identification of significant isolates was done by using standard microbiological techniques by using different biochemical media. In vitro antibiotic sensitivity test was done on Muller Hinton agar media using different antibiotics discs, and their sensitivity data was collected.

Result

Table 1 Common pattern of pathogens in different hospitals

Study site	Common pathogens for UTI
Hospital 'A'	E. coli (50%) > S. aureus (23.6%)> Klebsiella (2.6%)
Hospital 'B'	E. coli (56.6%) >S. aureus (36.6%) > Proteus species (6.6%)
Hospital 'C'	E. coli (69.2%) > S. aureus (10.2%) > Klebsiella (5.1%)
Hospital 'D'	E. coli (44.1%) > S. aureus (27.2%)> Klebsiella (12.9%)
Hospital 'E'	E. coli (43.3%) > S. aureus (23.3%) > Klebsiella (16.6%)

Table 2 Pattern of sensitivity of the common microorganism *E. coli* to antimicrobials in five different hospitals of Kathmandu valley.

Study site	Sensitivity pattern for *E. coli*
Hospital 'A'	Nitrofurantoin>ampicillin> nalidixic acid> norfloxacin > cotrimoxazole > amoxycillin> cephalosporin> ciprofloxacin.
Hospital 'B'	Amoxycillin > ciprofloxacin = cephalosporins >norfloxacin > ofloxacin > cotrimoxazole > nalidixic acid.
Hospital 'C'	Amikacin = gentamycin > cotrimoxazole = norfloxacin >nalidixic acid > nitrofurantoin > chloramphenicol > amoxycillin > ciprofloxacin.
Hospital 'D'	Amoxycillin > ciprofloxacin > ampicillin > cloxacillin > nalidixic acid > cotrimoxazole > cephalosporins = norfloxacin.
Hospital 'E'	Amoxycillin > nitrofurantoin = nalidixic acid > ampicillin > norfloxacin = tetracycline > cephalosporins > cotrimoxazole > ciprofloxacin.

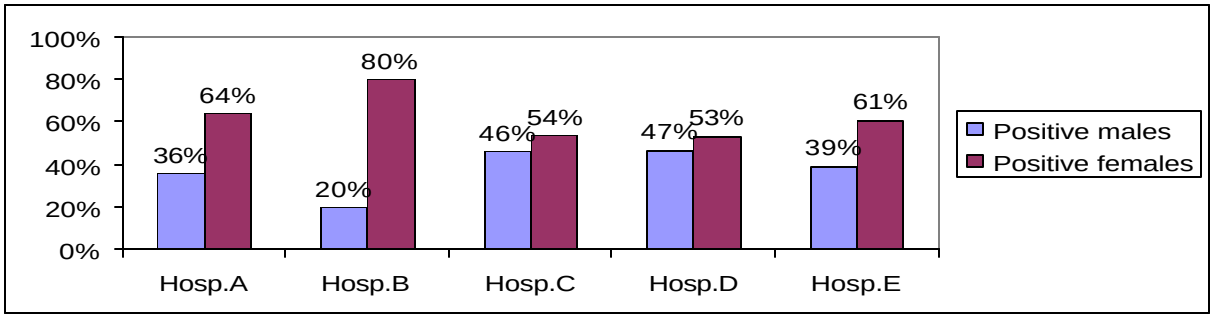
Table 3 Pattern of sensitivity of the common microorganism *S. aureus* to antimicrobials in five different hospitals of Kathmandu valley

Study site	Sensitivity pattern for *S. aureus*
Hospital 'A'	Cephalosporin> nitrofurantoin=ampicillin > cotrimoxazole > nalidixic acid > norfloxacin=amoxycillin.
Hospital 'B'	Ofloxacin > cephalosporin > cotrimoxazole = norfloxacin.
Hospital 'C'	Chloramphenicol = norfloxacin = nitrofurantoin = gentamycin > cotrimoxazole = nalidixic acid = amikacin = ciprofloxacin
Hospital 'D'	Norfloxacin > nalidixic acid >amoxycillin > ampicillin > cephalosporins > ciprofloxacin > cotrimoxazole > cloxacillin > nitrofurantoin.
Hospital 'E'	Ampicillin > cephalosporin = nitrofurantoin > nalidixic acid > ciprofloxacin > amoxycillin = cotrimoxazole > tetracycline.

Table 4 Pattern of sensitivity of the common microorganism *Klebsiella* to antimicrobials in five different hospitals of Kathmandu valley.

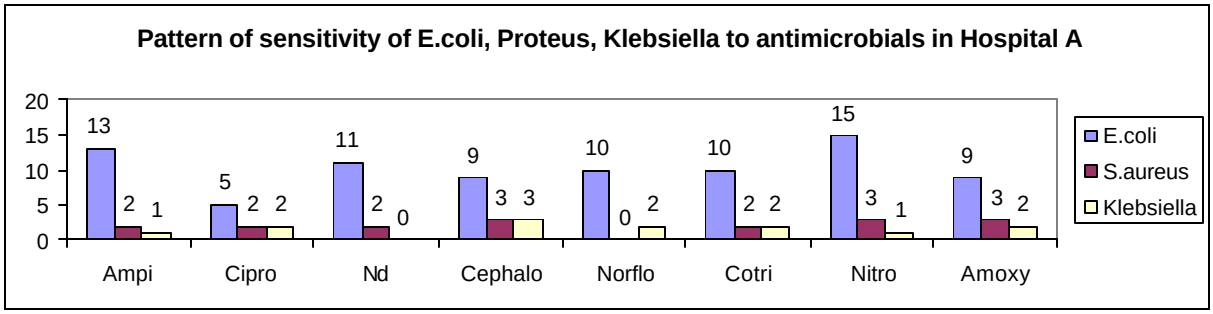
Study site	Sensitivity pattern for *Klebsiella*
Hospital 'A'	Cephalosporin> norfloxacin = cotrimoxazole = amoxycillin = ciprofloxacin.
Hospital 'B'	-
Hospital 'C'	Cotrimoxazole = norfloxacin = nitrofurantoin = amikacin > gentamycin = nalidixic acid > amoxycillin = ciprofloxacin = ofloxacin.
Hospital 'D'	Norfloxacin = cotrimoxazole = amoxycillin > ampicillin = ciprofloxacin > nitrofurantoin = cloxacillin > nalidixic acid > cephalosporin.
Hospital 'E'	Norfloxacin = amoxycillin > ampicillin = ciprofloxacin = nalidixic acid = cephalosporin = cotrimoxazole > nitrofurantoin > tetracycline.

Fig 1 Sex distribution of positive cases in different hospitals



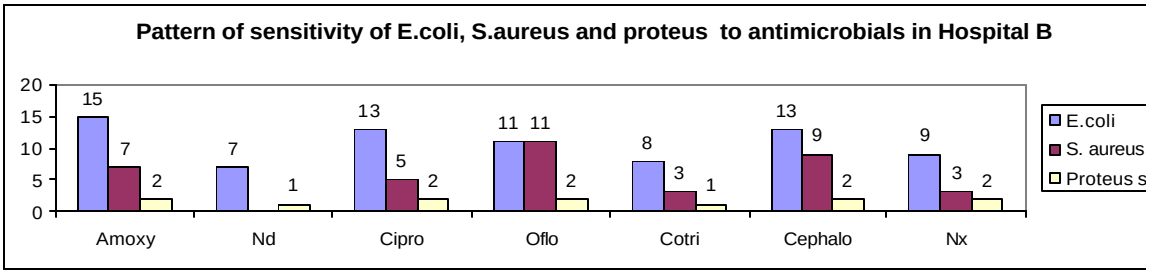
In all the hospitals, maximum females were suffering from UTI as compared to males.

Fig. 2 Pattern of sensitivity of E. coli, Proteus, Klebsiella and Pseudomonas to antimicrobials in Hospital A.



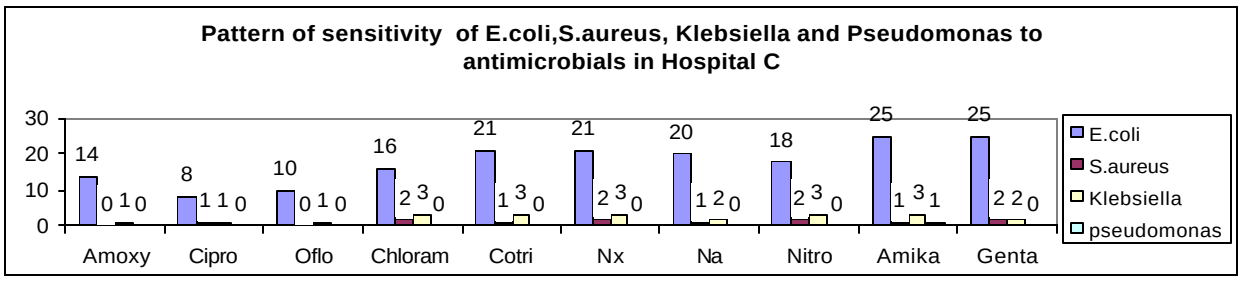
E. coli was most sensitive to nitrofurantoin, Proteus species was sensitive to cephalosporin and nitrofurantoin and Klebsiella was most sensitive to cephalosporin in hospital A.

Fig. 2 Pattern of sensitivity of E. coli, S. aureus and proteus to antimicrobials in Hospital B



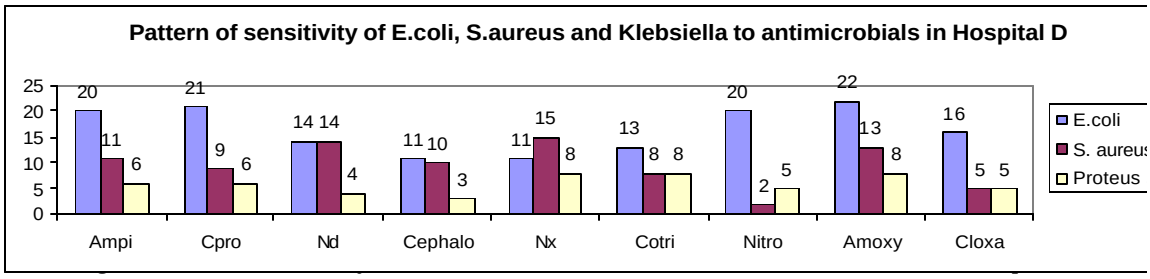
E. coli was most sensitive to amoxycillin, S. aureus was sensitive to ofloxacin and Proteus was most sensitive to amoxycillin, ciprofloxacin, ofloxacin, cephalosporin and nitrofurantoin in hospital B.

Fig. 4 Pattern of sensitivity of E. coli, Proteus, Klebsiella and Pseudomonas to antimicrobials in Hospital C



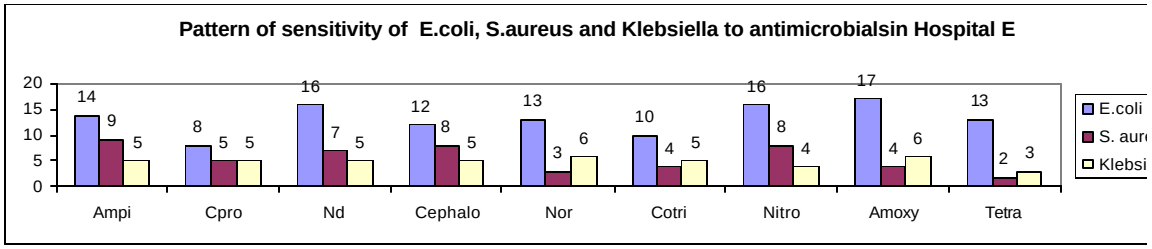
E. coli was most sensitive to amikacin and gentamycin, S. aureus was most sensitive to chloramphenicol, norfloxacin, nitrofurantoin and gentamycin in hospital C.

Fig. 5 Pattern of sensitivity of E. coli, S. aureus and Klebsiella to antimicrobials in hospital D



E. coli was most sensitive to amoxycillin, S. aureus was most sensitive to norfloxacin and Proteus species were most sensitive to norfloxacin, amoxycillin and cotrimoxazole in hospital D.

Fig. 5 Pattern of sensitivity of E. coli, S. aureus and Klebsiella to antimicrobials in hospital E



E. coli was most sensitive to amoxycillin, S. aureus was most sensitive to ampicillin and Klebsiella was most sensitive to norfloxacin and amoxycillin in hospital E.

In brief, the following salient observations were made:

- Urinary tract infection (UTI) was much more common in females than in males. In four hospitals, the female sufferers were 53-80% and males were 20-47%, however, in hospital B, the female population was 80% and male was 20%.

Age group

- In four hospitals, the incidence of UTI was maximum in females of age group 21-30, where as in males, it was 31-40, but in hospital A, the age group for males was 71-80 and for females was 31-40.

Organism

- Altogether six species of bacteria were isolated, E .coli, S. aureus, Klebsiella, Staph. aureus, Pseudomonas and Citrobacter.
- The most common organism was E. coli, followed by S. aureus and Klebsiella. E. coli was found to be maximum in hospital C (69%) and minimum in hospital D and E (43%).
- Minimum prevalent organism was Pseudomonas. It was nil in hospital B, 5% in hospital D and E and only 1% in hospital A and C.

Antimicrobials

- The antimicrobials tested for sensitivity in the urine culture in all the hospitals were almost the same, i.e., ampicillin, ciprofloxacin, nalidixic acid, cephalosporin, norfloxacin, cotrimoxazole, nitrofurantoin, amoxycillin, ofloxacin, chloramphenicol, cloxacillin and tetracycline, except in the hospital C where amikacin and gentamycin were also tested.
- Nitrofurantoin and amoxycillin were observed to be the most common antibiotic used and were found to be most effective in most of the organisms in all the hospitals.
- Ciprofloxacin was found to be the least effective antimicrobial in all the hospitals.
- The sensitivity of the organisms observed was as follows:
- E. coli was found to be most sensitive;
  - To amoxycillin in three hospitals, i.e., B, (88.2%), D (64.7%) and E (65.3%).
  - To amikacin and gentamycin in one hospital, i.e., C (92.5%) and
  - To nitrofurantoin in hospital A (78%).
- S. aureus was most sensitive to cephalosporin (88.8%) followed by nitrofurantoin (77.7%), amikacin (80.6%) and norfloxacin (65.5%).
- Klebsiella was most sensitive to norfloxacin (75%) and nitrofurantoin (75%).
- Pseudomonas was observed to be resistant to all the antimicrobials in all the hospitals except hospital C, where it was found to be sensitive to amikacin (100%) in hospital C.

Discussion

A study of UTI was conducted on the basis of the reports of urine culture from the microbiology laboratories of 5 hospitals of Kathmandu. An analysis of the data for different aspects reveals the pattern of UTI prevalent according to sex, age, organism

affecting and the antimicrobials used and are effective.

The observations are mostly concurrent with the reports available in the literature though some significant differences were observed which are reported in this study.

As is well known, females are more susceptible to UTI than males. In this study, this fact was confirmed in all the hospitals where the percentage was 53-80% for females and 20-47% in males and in hospital B, females were much more i.e., 80%. Various factors could be responsible, like diagnosis and age of the patient. Hospital B is a specialty hospital for nephrology and all the investigations and treatment of renal diseases and UTI exist there. Choices of nosocomial infections are much more common because of prevalence of patients suffering from renal problems and since females are more susceptible to catch UTI, their percentage was maximum in this hospital.

In males, UTI was found to be most prevalent in the age group of 31-40 and in age group of 21-30 in females. These findings are concurrent with the reports available in the literature. Prevalence of UTI in females is 3% at the age of 20 years, increasing by 1% every subsequent decade[50]. However, in the hospital A, males were 71-80%. Though a definite reasoning cannot be put forward for this observation, it could be that since most of the reports of urine from the microbiology laboratory of hospital A were of male post operative patients, the number of males showing UTI was much more, however, this is worth investigation. In our study, E. coli infection was found to be higher in females which are similar to the report of other researchers [14, 15, 16, 17, 18].

The most prevalent organism found was E. coli (69%), which is confirmatory to the literature available. Higher prevalence of E. coli followed by S. aureus and Klebsiella in this study resembles to the various studies done by different scientists in different parts of the world [13, 15, 19, 20, 21].

95% of gram negative bacilli are responsible for UTI. E. coli is dominant for outpatients as well as indoor patients .80% of UTI is caused by E. coli followed by streptococcus or staphylococcus and Proteus [22], whereas, pseudomonas was found to be the least common.

Amongst the antimicrobials used, most of the organisms were sensitive to amoxycillin, whereas pseudomonas was found to be resistant to all the antimicrobials except amikacin, though this was tested only in hospital C and it is likely that in other hospitals too pseudomonas would be found to be sensitive to amikacin.

In our study, though E. coli was found to be most sensitive to amoxycillin, cotrimoxazole [23] is the first choice according to Goodman and Gillman**,** followed by ciprofloxacin, and then second generation cephalosporin.

Cotrimoxazole has an additional advantage that it is the cheapest. The reason for more common use of amoxycillin in the hospitals in Kathmandu could not be ascertained.

First group of drug of choice for Klebsiella are cephalosporin [17, 23, 24] (second generation), followed by aminoglycosides, cotrimoxazole and ciprofloxacin. Similarly, for Proteus, drug of first choice is ampicillin followed by second generation cephalosporin and ciprofloxacin.

Though the present analysis is in confirmatory with the literature available, some minor variations have been observed, the most significant being the prevalent use of amoxicillin for UTI caused by E. coli in place of cotrimoxazole which has an additional advantage of being cheaper than amoxycillin and secondly, use of amikacin and gentamycin, which are very nephrotoxic, for infections caused by pseudomonas.

Acknowledgement

The author gratefully acknowledges the financial support extended by KMC research committee. and also to all the microbiology laboratory staff of the five hospitals i.e., Kathmandu Medical College Teaching Hospital, Sinamangal, Tribhuwan University Teaching Hospital, Maharajgunj, Shukraraj Hospital for Tropical and Infectious Diseases, Teku, Medicare National Hospital and Research Centre, Chabahil and Central laboratory, Teku for their kind support for making the data available to me. I acknowledge with thanks the assistance of Bikram Adhikary, Amrit Koirala and Pukar Thapa, third year students of Kathmandu Medical College, and the students of Third year B. Pharm, Tribhuwan University Teaching Hospital for their kind help to collect the data. I am also grateful to Mr. C. P. Bhatta, Asst. Professor of Microbiology, Kathmandu Medical College for his help to materialize this work

References

1. Centre for Disease Control: National Nosocomial Infection Study Report. Atlanta, 1979, Centre for Diseased Control, pp. 2-14.
2. Leigh D. Urinary-tract infections. In: Smith

GR, Easma Charles SF, eds. Topley and Wilson's principles of bacteriology, virology and immunity, volume 3. Bacterial disease. 8th edition. Frome and London: Butler and Tanler Ltd.1990; 197-214.
3. Palac, DM. Urinary tract infection in women. A physician's perspective, 1986: pg 17-25.
4. DoHS annual report of 2055/56, Department of health service HMG Nepal, 2000.
5. Delzell JE, and Lefevre ML. Urinary tract infection during pregnancy. Amfam physician, 2000; 61:713-721.
6. Conolly A. Throp JM, Urinary tract infection in pregnancy. Urol Clin NorthAm 1996:26:778-779.
7. DoHS annual report of 2055/56, Department of health service HMG Nepal, 2000.
8. Calva JJ, Sifuentes-Osornio J, Ceron C. Antimicrobial resistance in fecal flora: longitudinal community-based surveillance of children from urban Mexico. Antimicrob Agents Chemother 1996; 40:1699-702.
9. Lamikanra A, Okeke IN. A study of the effect of the urban/rural divide on the incidence of antibiotic resistance in Escherichia coli. Biomed Lett 1997; 55:91-7.
10. Hoge CW, Gambel JM, Srijan A, Pitarangsi C, Echeverria P. Trends in antibiotic resistance among diarrheal pathogens isolated in Thailand over 15 years. Clin Infect Dis 1998; 26:341-5.
11. Hart CA, Kariuki S. Antimicrobial resistance in developing countries. Br Med J 1998; 317:647-50.
12. O'Brien T. The global epidemic nature of antimicrobial resistance and the need to monitor and manage it locally. Clin Infect Dis 1997; 24 Suppl 1:S2-8.
13. Sharma PR. Urinary infection – The infection that matters. J Inst Med 1983; 5 (1): 19-22.
14. Leigh D. Urinary-tract infections. In: Smith GR, Easma Charles SF,eds. Topley and Wilson's principles of bacteriology, virology and immunity, volume 3. Bacterial disease. 8th edition. Frome and London: Butler and Tanler Ltd.1990; 197-214.
15. Obi CL, Tarupiwa A, Simango C. Scope of urine pathogens isolated in the Public Health bacteriological Laboratory, Harare: Antibiotic susceptibility patterns isolates and incidence of hemolytic bacteria. Centre for African Journal of Medicine 1996; 42 (8)|: 244-249.
16. Tsunoda K, Goya N, Miyazaki Y, et al. Bacterial flora of the urinary tract and their drug sensitivity: 2 years clinical statistics in Sanskinkai Hara Hospital, Japan Nishinihon J urol 1979; 41 (2): 337-345.
17. Manandhar S. microbiology of urinary tract infection: A hospital based study. A dissertation presented to the Central Department of Microbiology, Tribhuwan University 1995.
18. Gautam K. Prevalence of urinary tract infection in children. A dissertation presented to the Central Department of Microbiology, Tribhuwan University 1998 March.
19. Kosakai N, Kumamoto Y, Hirose T et al. Comparative studies on activities of antimicrobial agents, again causative organisms isolated from urinary tract infection. 1987:II. Background of patients. Jpn J Antibiot 1994 43 (6):454-967.
20. Chattopadhye AK, Mandal AK. Microbes associated with urinary tract infection in Burdwan, West Bengal. Indian Journal of Physiology and Allied Sciences 1993; 47 (2): 67-72.
21. Glikberg F, Brawer-Ostrovsky Y. Urinary tract infection in the community. Harefuah 1993; 125(1-2): 16-18, 63.
22. Davidson's Principles and practice of medicine. 18th edition, Churchill Livingstone, 1999. International edition ISBN 0443060002.
23. Goodman and Gilman's, The Pharmacological Basis of Therapeutics, 9th edition, International edition, McGraw - Hill.
24. R.S.Satoskar, S.D. Bhandarkar, S.S. Ainapure, Mumbai Popular Prakashan.