Zankat VA et al. GAIMS J Med Sci 2023; 3(2) (Jul-Dec):43-48
Online ISSN: 2583-1763

Original Research Article

Study of Urinary Tract Infection in Diabetic and Non-Diabetic Patients at Tertiary Care Centre, Jamnagar, Gujarat

Vibhuti A. Zankat[1], Rashmika Parmar[1], Hitesh K. Shingala[1], Krunal D. Mehta[1]

[1]Department of Microbiology, Shri M.P. Shah Medical College, Jamnagar, Gujarat
*Correspondence: Dr.Krunal D. Mehta (drkrunalmehta22@gmail.com)

ABSTRACT

Introduction: Urinary tract infection is the second most common hospital- acquired infection and recognized as a significant problem in diabetic patients. UTI increases morbidity in diabetic patients because sugar serves as the growth medium for uropathogens. Complications due to UTIs are more in diabetics compared to non-diabetic patients.

Aims and objectives: To detect uropathogens and their antibiotic susceptibility pattern in Urinary Tract Infections in diabetic and non-diabetic patients.

Material and Methods: The retrospective study was conducted from June 2022 to August 2022 in 136 diabetic and 101 non-diabetic patients having culture positive for urinary tract infection. Urine samples were cultured and examined for bacterial growth by various microbiological methods. After the identification of the bacterial pathogen, antimicrobial susceptibility testing was done on Muller Hinton agar according to CLSI guidelines.

Results: A total of 237 culture-positive patients of UTI were studied, 136(57.4%) were diabetics and 101(42.6%) were non-diabetics. Escherichia coli was the most common isolated organism in diabetics (63.9%) and non-diabetics (66.4%), followed by Klebsiella pneumoniae in diabetics (15.4%) and non-diabetics (15.9%). There were no significant differences in the prevalence of Pseudomonas aeruginosa, Acinetobacter baumannii, Staphylococcus aureus, and Enterococcus spp., in both groups. No significant difference in the antibiotic sensitivity pattern of both groups.

Conclusions: The prevalence of UTIs were high in diabetics than non- diabetics. In both groups, E.coli was the most common organism followed by Klebsiella. E.coli from diabetics and non-diabetics have demonstrated higher resistance to cephalosporins and sensitivity to Nitrofurantoin, Sparfloxacin, Piperacillin-Tazobactam, Imipenam and Gatifloxacin.

Key Words: Urinary Tract Infection, Diabetics, Non-diabetics, Antibiotic Sensitivity

INTRODUCTION

Urinary tract infection is a disease caused by microbial invasion of the urinary tract that extends from the renal cortex of the kidney to the urethral meatus. The most common bacterial infection that needs medical care and second most common infection after respiratory tract infection in the community. Prevalence in female is more due to the short urethra, proximity to the anus and hormonal changes.[1]

Diabetes mellitus is a predisposing factor for urinary tract infection.[2] Bacteriuria is more common in diabetics because of the combination of host and local risk factor.[3] Increased prevalence of UTI in diabetics due to altered immunity,[4] Glycosuria provides a growth medium for bacteria. Polymorphonuclear leukocyte function, chemotaxis, Leukocyte adherence and phagocytosis are affected in diabetic patients. The carbohydrate composition of the receptor of cells increase adherence of microorganisms and it becomes more virulent in high glucose environment.[5] Urinary tract infections in diabetics patients are mostly asymptomatic but poor diabetic control, acute keto acidosis or a diabetic complication such as nephropathy, neuropathy and vasculopathy can cause severe kidney damage and renal failure. So investigation of bacteriuria is very important to prevent the development of renal complications of diabetes and severe renal damage and failure.[6] most common bacteria causing UTI in diabetics and non-diabetics are Escherichia coli, Klebsiella spp., Pseudomonas aeuginosa, Acinetobacter baumannii, Staphylococcus aureus and Enterococcus spp.[7] Antimicrobial resistance among uropathogens increase UTI prevalence. The study was aimed to detect causative agents of UTI and their antibiotic profile in diabetics and non-diabetics.

METHODOLOGY

Sample Collection
The retrospective study was conducted in the Department of microbiology at Shri M.P. Shah medical college, Jamnagar over a period of three months from June 2022 to August 2022 after obtaining approval from an Institutional Ethics Committee. Patients less than 18 years and culture negative for urinary tract infection were excluded from the study. Midstream urine was collected in sterile urine container from patients. All the samples were immediately brought to the laboratory and proceeded as per standard protocols.

Sample Processing
Smear was prepared from collected samples and gram staining was done to identify any pathogenic organism. Then urine samples were inoculated on blood agar and Mac Conkey agar and incubated at 37º C for 16 to 18 hours. Identification of isolates were done based on colony morphology, gram stain appearance, conventional biochemical test, oxidase, catalase test and motility. After confirmation of the microorganism, Antibiotic susceptibility testing was done by the Kirby Bauer disc diffusion method on Mueller-Hinton agar to determine the sensitivity pattern of the microorganisms. Antibiotic discs were placed onto the Muller Hinton agar plate and incubated at 37ºC for 16 to 18 hours. After incubation, zones of inhibition were noted, measured, and compared with reference zones in accordance with CLSI guidelines 2022(M100-Ed32). Data were collected from 237 culture-positive patients for UTI of diabetics and non-diabetics patients & data were analyzed by using appropriate statistical methods. Antibiotics which were used are Ampicillin/Sulbactam (20 mg), Co-trimoxazole (25mcg), Cephalexin (30mcg), Tetracycline (30mcg), and Ciprofloxacin (5mcg). Other specific antibiotics for gram-negative bacteria were: Ceftizoxime (30mcg), Nitrofurantoin (300mcg), Sparfloxacin (10mcg), Gatifloxacin (10mcg), Norfloxacin (10 mcg), Ofloxacin (5mcg), Piperacillin/Tazobactam (100/10mcg), Imipenem (10mcg) and specific for gram-positive bacteria were: Cefotaxime (30mcg), Levofloxacin (5mcg), Linezolid (30mcg), Cloxacillin (1mcg), Roxithromycin(15mcg), Lincomycin (2mcg), Gentamycin (10mcg), Cefoxitin (30mcg).

RESULTS

Out of 237 culture-positive patients for UTI, 136(57.4%) were diabetics and 101(42.6%) were non-diabetics (Figure-1)

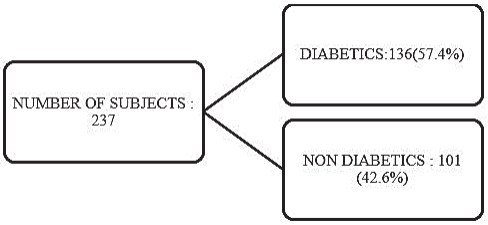

Figure 1: Distribution of diabetics and non-diabetics among subjects.

Chart 1 shows gender wise distribution of UTI in diabetics and non-diabetics in which, females were 74(54.4%) and males were 62(45.6%) from 136 diabetics and from 101 non-diabetics, females were 57(56.4%) and males were 44(43.6%). It shows a higher prevalence of UTI in females in both groups.

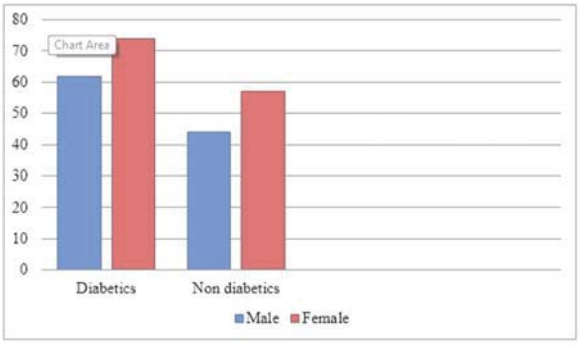

Chart 1: Gender-wise distribution of UTI in diabetics and non-diabetics.

The majority of the diabetic participants were between the age 50-59(27.2%) years and in non-diabetic were between 30-39(27.8%) years. Table 1 shows age wise distribution of UTI in diabetics and non-diabetics.

Age Distribution	Diabetics	Non Diabetics
18-29 years	-	11 (10.9%)
30-39 years	4(2.9%)	28 (27.8%)
40-49 years	24(17.6%)	10 (9.9%)
50-59 years	37(27.2%)	12 (11.9%)
60-69 years	35 (25.7%)	21 (20.8%)
70-79 years	30 (22.1%)	15 (14.8%)
>80 years	6 (4.5%)	4 (3.9%)
Total	136	101

Table 1: Age-wise distribution of UTI among diabetics and non-diabetics.

In both groups, Gram-negative isolates were predominant. The most common organisms isolated from diabetics and non-diabetics were Escherichia coli followed by Klebsiella pneumoniae, Pseudomonas aeruginosa, Staphylococcus aureus and Enterococcus faecalis. E.coli were 87(63.9%) in diabetics and 67(66.4%) were in non-diabetics. Chart 2 and 3 shows the isolation of different uro pathogens in diabetics and non-diabetics respectively.

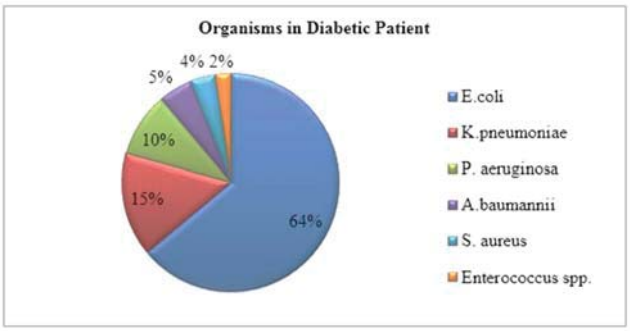

Chart 2: Isolation of different uropathogens in diabetic patients.

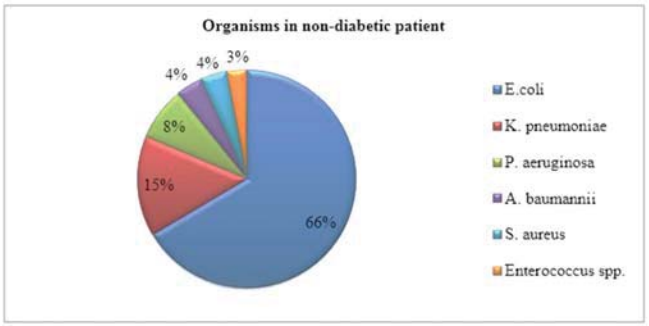

Chart 3: Isolation of different uropathogens in non-diabetic patients.

Gram negative-organisms from both group were found to be highly sensitive to Nitrofurantoin, Piperacillin/Tazobactam and Imipenem and resistant to Ampicillin-sulbactam, Co-trimoxazole, Cephalexin, Ciprofloxacin, Ceftizoxime. Table 2 shows antibiotic sensitivity in both groups.

DISCUSSION

Urinary tract infection is one of the most common infection diagnosed by clinician[4] and second most common infection which need medical care. Diabetic patients are more prone to UTI because glucose serves as the medium for the growth of bacteria. Females are more prone to get UTIs than males due to their anatomy and reproductive physiology.[8] Prevalence of UTI as Hospital Acquired Infection is 35%.[1] Urine culture and sensitivity is the investigation of choice for isolating uropathogens.[4]

The current study was conducted to find out the UTI in diabetics and non-diabetics, etiological agents causing UTI and their antibiotic susceptibility. Increased occurrence of UTI among diaebtics might be due to decreased antibacterial activity, neutrophil dysfunction and increased adherence to uropepithelial cells.[9, 10] in diabetic, neuropathy can result in urinary retention and can lead to infection.

Thus, the frequency of UTIs in diabetic patients were 57.4% in this study, where as it was 52.76%, reported by Zubair KU et al.[11]. Studies from Andhra Pradesh6 and Nepal[12] reported 59.3% and 54.76% respectively.

Few studies found less prevalence of UTI than current study which include Gillani et al.[13] (29.2%) and Shah MA et al.[8] (40.2%). High rate in this study might be due to poor personal hygiene practices, geographical variation and lack of health education.[1]

Most of studies reported higher prevalence of UTI in female than male and UTI is known as disease of female.[14] It is due to decrease of normal vaginal flora (Lactobacilli), less acidic pH of vagina, absence of bacteriostatic prostatic secretion and poor hygienic condition etc.[9,10] Anus is proximal to urinary tract which also increase prevalence in female.

And due to these reasons, prevalence of UTI in diabetic (54.4% in female vs 45.6% in male) and in non-diabetic (56.4% in female vs 43.6% in male) is comparable to Kumar R et al.[15] (56.3% in female vs 43.7% in male in diabetic and 62.4% in female vs 37.6% in male in non-diabetic).

Diabetes is more common in elderly and diabetic patients are vulnerable to infection including UTI due to low immunity. In present study, UTI in diabetic was common in age group 50-59 years followed by 60-69 years which is comparable to Zubair KU et al.11 (51-60 years), Kumar R et al.15 (40-60 years) and Njunda et al.16 (41-60 years). Study from Andhra Pradesh6 shows more UTI in age group 60-69 years in non-diabetic but in this study it was between 30-39 years. It might be due to high prevalence of UTI in reproductive age.

Higher prevalence of E. coli is due to the fact that it is bowel commensal and cause contamination due to poor hygiene. E.coli and K. pneumoniae can bind with glycoconjugate receptors of the epithelial cells of urinary tract and initiate infection.[9]

There was no significant difference in isolated organisms of both groups in this study. E.coli was the most common isolated organism 63.9% and 66.4% followed by K. pneumoniae 15.4% and 14.9% in diabetic and in non-diabetic respectively. It is in line with study from Mangalore4 56% and 71% for E.coli and 16% and 13% for K. pneumoniae, 64.6% and 58.9% for E.coli and 12.2% and 14.5% for K.pneumoniae from Andhra Pradesh.[6] Kumar R et al.[15] reported 60% and 72.2% for E.coli and 17.1% and 11.1% for K. pneumoniae.

Diabetic patients are in immune suppressed state so they are at higher risk for Pseudomonas aeruginosa and Acinetobacter baumannii infection because these organisms can survive in hospital environment for long period.[4,1]

P. aeruginosa was 7.9% and 9.6% in diabetic and non-diabetic respectively is similar to the study of Bamnote P. et al.17 5.7% in diabetic and 10.7% in non-diabetic, Kande S. et al.[18] shows 4.6% in diabetics.

In this study, Acinetobacter baumannii isolated 5.1% and 3.9% which is similar to 5% and 2% in diabetic and non-diabetic respectively in study of Mangalore.[4]

Enterococcus faecalis were 2.3% in diabetic which is similar to study conducted by Chiță T et al.[19] 2.6% and Gutema T. et al.[2] 2.6%.

Antibiotic Tested	***Escherichia coli***		***Klebsiellapneumoniae***		***Pseudomonas aeruginosa***		***Acinetobacterbaumannii***	
	DM	**NDM**	**DM**	**NDM**	**DM**	**NDM**	**DM**	**NDM**
Ampicillin/ Sulbactam	29.9%	35.8%	9.5%	6.7%	IR	IR	IR	IR
Co-trimoxazole	44.8%	49.2%	52.3%	60%	IR	IR	50%	42.8%
Cephalexin	28.7%	31.4%	38.1%	33.3%	R	R	R	R
Tetracycline	48.3%	53.7%	52.3%	66.7%	IR	IR	14.2%	25%
Ciprofloxacin	21.8%	34.3%	33.3%	26.7%	46.2%	50%	57.1%	50%
Ceftizoxime	28.7%	29.8%	47.6%	53.3%	R	R	28.6%	50%
Nitrofurantoin	89.6%	91%	85.7%	80%	46.1%	37.5%	71.4%	75%
Sparfloxacin	86.2%	88.1%	76.2%	73.3%	61.5%	62.5%	71.4%	75%
Gatifloxacin	80.4%	83.6%	66.7%	73.3%	53.8%	50%	71.4%	75%
Norfloxacin	19.5%	29.9%	28.6%	33.3%	46.1%	50%	57.1%	75%
Ofloxacin	20.7%	26.8%	23.8%	33.3%	38.4%	37.5%	42.8%	50%
Piperacillin/ Tazobactam	86.2%	80.6%	85.7%	93.3%	100%	100%	85%	100%
Imipenem	100%	91%	90.5%	80%	100%	100%	100%	100%

IR- Intrinsic Resistance

R-Resistance to antibiotic

Table 2: Comparison of Antibiotic Sensitivity of Gram Negative Organisms between diabetic and non-diabetic

In diabetic patients, UTIs are more severe, caused by more resistant pathogens, and are associated with worse outcomes than in patients without diabetes. Diabetic patients are more prone to get UTI from drug-resistant microorganisms. So that, a urine culture might be required to rule out the bacteria responsible for the infection and to determine the antibiotic susceptiility to treat the infection.

In this study E.coli was sensitive to Nitrofurantoin 89.6% and 91%, Ciprofloxacin 21.8% and 34.3%, Norfloxacin 19.5% and 29.9%, Imipenem 100% and 100% in diabetic and non-diabetic respectively which is comparable to Nitrofurantoin 84% and 86%, Ciprofloxacin 13% and 28%, Norfloxacin 18% and 27%, Imipenem 100% and 100% in diabetic and non-diabetic respectively in Andhra Pradesh[6] study Also comparable with

Zubair KU et al.[11] Sensitivity patterns depend on nature of organisms and use of antibiotic without restriction.[11] Resistance to common antibiotic drugs are due to either treating Urinary tract infection empirically without antibiotic susceptibility test or antibiotic susceptibility test are done when patients fail to improve after administration of one or more antibiotic.[12]

K. pneumoniae was sensitivite to Co-trimoxazole 52.3% and 60%, Gatifloxacin 66.7% and 73.3% in diabetics and non-diabetic respectively which is comparable to study of Andhra Pradesh6 observed Co-trimoxazole 50% and 64%, Gatifloxacin 60% and 54% in diabetic and non-diabetic respectively. P.aeruginosa and Enterocccus spp.can develop resistance by exploting various mechanism can be hard to manage.[12]

In this study, P.aeruginosa was 100% sensitivite to Piperacillin Tazobactam in diabetic which is similar to 82% observed by Gutema T et al.[2]

Antibiotic Tested	***Staphylococcus aureus***		***Enterococcus fecalis***	
	DM	**NDM**	**DM**	**NDM**
Ampicillin/ Sulbactam	40%	50%	R	33.3%
Co-trimoxazole	80%	75%	66.6%	33.3%
Cephalexin	60%	50%	66.6%	33.3%
Tetracycline	60%	75%	33.3%	33.3%
Ciprofloxacin	40%	50%	33.3%	66.6%
Cefotaxime	40%	50%	R	33.3%
Levofloxacin	40%	75%	33.3%	33.3%
Linezolid	100%	100%	66.6%	100%
Cloxacillin	40%	25%	R	33.3%
Roxythromycin	40%	50%	33.3%	33.3%
Lincomycin	100%	100%	33.3%	66.6%
Gentamycin	80%	100%	33.3%	33.3%
Cefoxitin	60%	75%	R	33.3%

R: Resistance to Antibiotic

Table 3: Comparison of Antibiotic Sensitivity of Gram-positive Organisms between diabetic and non-diabetic

In gram-positive organism S.aueus and Enterocccus spp., of both groups were 100% sensitivite to Linezolid which is similar to a study of Andhra Pradesh[6] (100%).

CONCLUSIONS

This study concluded that the prevalence of UTI was higher in diabetics than non-diabetic. Also observed that females were more common than males. Gram-negative organisms were more in which Escherichia coli was the principal uropathogen. Nitrofurantoin, Sparfloxacin, and Imipenem were more sensitive in gram-negative isolates. Gram-positive organisms were more sensitive to Linezolid and Gentamycin. So early diagnosis and treatment of diabetic patients are necessary to prevent complications. The sensitivity pattern of uropathogen to common antibiotics must be taken into account when selecting treatment. Routine surveillance and monitoring of diabetic patients should be conducted. Antimicrobial Stewardship program should be established to rationalize the use of antimicrobial agents.

ACKNOWLEDGMENTS

Authors thanks all the staff members of the microbiology department for their help and support.

REFERENCES

1. Sastry A S. Essential of Medical Micrbilogy. 3rd ed. Jaypee Brothers medical publisher, New Delhi (India), 2021. p.241,769
2. Gutema T, Weldegebreal F, Marami D, Teklemariam Z. Prevalence, Antimicrobial Susceptibility Pattern, and Associated Factors of Urinary Tract Infections among Adult Diabetic Patients at Metu Karl Heinz Referral Hospital, Southwest Ethiopia. Int J Microbiol. 2018 Nov 1; 2018:7591259. doi: 10.1155/2018/7591259. PMID: 30515216; PMCID: PMC6236978.
3. Patterson JE, Andriole VT. Bacterial urinary tract infections in diabetes. Infect Dis Clin North Am. 1997 Sep; 11(3):735-50. doi: 10.1016/s0891-5520(05)70383-4. PMID: 9378933.
4. Kellarai A, Parakash PS. Pattern and Presentation of Urinary Tract Infection in Diabetic and Non Diabetic Population. MediSys Journal of Medical Sciences. 2020;1(1): 08-14
5. Geerlings SE, Hoepelman AI. Immune dysfunction in patients with diabetes mellitus (DM). FEMS Immunol Med Microbiol. 1999 Dec; 26(3-4):259-65. doi: 10.1111/j.1574-695X.1999.tb01397.x. PMID: 10575137.
6. Vinod CSS, Nareddy VA, M.V. Nagabhushana. A clinical study of urinary tract infections in diabetics and non-diabetics patients. Int J Adv Med 2019; 6:1421-9.
7. Hamdan HZ, Kubbara E, Adam AM, Hassan OS, Suliman SO, Adam I. Urinary tract infections and antimicrobial sensitivity among diabetic patients at Khartoum, Sudan. Ann ClinMicrobiolAntimicrob. 2015 Apr 21; 14:26. doi: 10.1186/s12941-015-0082-4. PMID: 25896611; PMCID: PMC4406170.
8. Shah MA, Kassab YW, Anwar MF, Al-dahoul HK, Menon S, et al. (2019) Prevalence and associated factors of urinary tract infections among diabetic patients. Health Sci J Vol.13.No.2:646
9. M. Cheesbrough, District Laboratory Practice in Tropical Countries, Part 2, Cambridge University Press, New York, NY, USA, 2006.
10. K.Yadav and S. Prakash, "Antimicrobial resistance pattern of uropathogens causing urinary tract infection (UTI) among diabetics," Biomedical Research International, vol. 1, pp. 7–15, 2016. View at: Google Scholar
11. Zubair KU, Shah AH, Fawwad A, Sabir R, Butt A. Frequency of urinary tract infection and antibiotic sensitivity of uropathogens in patients with diabetes . Pak J Med Sci. 2019; 35(6):1664-1668. doi: https://doi.org/ 10.12669/pjms .35.6.115
12. Jha, Pramod&Baral, Ratna & Khanal, Basudha. (2014). Prevalence of Uropathogens in Diabetic Patients and Their Susceptibility Pattern at a Tertiary Care Center in Nepal-A Retrospective Study. 3. 29-34.
13. Gillani SW, Azhar S, Sulaiman S, Sundram S (2012) Prediction and rate of infections in diabetes mellitus patients with diabetes ketoacidosis in Penang. Malaysia. J Epidemiol 2: 1-6.
14. Bilal M, Haseeb A, Rehman A, Arshad MH, Aslam A, Godil S, et al. Knowledge, attitudes, and practices among nurses in Pakistan towards diabetic foot. Cureus. 2018;10(7):e3001. doi: 10.7759/cureus.3001.
15. Kumar R, Kumar R, Perswani P, et al. (August 22, 2019) Clinical and Microbiological Profile of Urinary Tract Infections in Diabetic versus Non-Diabetic Individuals. Cureus 11(8): e5464. DOI 10.7759/cureus.5464
16. Njunda AL, Assob NJC, Nsagha SD, Nde FP, Kamga FHL, et al. (2012) Uropathogens from diabetic patients with asymptomatic bacteriuria and UTIs. Scientific J Microbiol 1: 141-146.
17. Bamnote, P.T., Ovhal, R.S., Kulkarni, D.M., & More, S.K. (2020). Prevalence of urinary tract infections and its antibiogram in diabetic and non-diabetic patients attending tertiary care hospital in Maharashtra. IP International Journal of Medical Microbiology and Tropical Diseases.
18. Kande S, Patro S, Panigrahi A, Khora PK, Pattnaik D. Prevalence of uropathogens and their antimicrobial resistance pattern among adult diabetic patients. Indian J Public Health. 2021 Jul-Sep; 65(3):280-286. doi: 10.4103/ijph.IJPH _1413_20. PMID: 34558491.
19. Chiță T, Licker M, Sima A, Vlad A, Timar B, Sabo P, Timar R. Prevalence Of Urinary Tract Infections In Diabetic Patients. RJDNMD [Internet]. 15Jun.2013 [cited 16Nov.2022];20(2):99-05. Available from: https://rjdnmd.org/index.php/ RJDNMD/ article/view/22

Source of support: Nil

Conflict of interest: None declared

How to cite: Zankat VA, Parmar R, Shingala HK, Mehta KD. Study of Urinary Tract Infection in Diabetic and Non-Diabetic Patients at Tertiary Care Centre, Jamnagar, Gujarat. GAIMS J Med Sci 2023; 3(2):43-48. https://doi.org/10.5281/zenodo.8091830