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The Incidence of Bacterial Urinary Tract Infections and Associated Risk FactorsamongPatientsofControlledandUncontrolledDiabetesMellitusin Sana'a City- Yemen

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Abstract:

Thehighprevalenceof UTIs amongDM patients, whichattributetovarious impairmentsintheimmunesystem (lowurinaryconcentrationof interleukin -8andinterleukin -6,lowerurinaryleucocytecellcount). Inaddition, poormetaboliccontrolandincompletebladderemptyingdueto autonomicneuropathymayall contributetotheenhancedriskof UTIsinthesepatientsDM isassociatedwithUTIs throughitseffectonthehostimmunesystem .Therefore detect the incidence of bacterial UTIs in controlled and uncontrolled DM patients in Sana'a City- Yemen, Determine the suitable antibioticssusceptibilityagainstbacterial UTIsin controlledanduncontrolledDMpatients, Exploretherelationshipbetweenbacterial UTIs and the main risk factorsin controlledanduncontrolledDMpatients. In this cross- sectional study , urine sample were collected from 225 participants fromProf. Mohammed Bamashmous Internal Medicine,Republication Authorized Teaching, Al-Olaqi Specialized Laboratories and Baghdad Laboratories The sample was processed by physical, chemical and microscopic examination andcultured in CLED agar, Maconky agar and blood agar, afterincubation the sample in 37^0C aerobicallywas proceed by Gram stain and biochemical test . Amongthe225 analyzed samples, 49 (21.8%) were showing sterile urine samples, while 9 (4.0%) showed mixed growth of bacteria possibly due to improper collection of the sample.The remaining 122 (54.2%) samples were positive(significant)with colony count 10^5CFU|ml, 34 (15.1%)ware positive(suspected) with colony count 10^3-10^4 CFU\ml , 11(4.9%)ware non-significant withcolonycount-less than$10^2$for The number of subjects withUTI was clearlyhigher intheuncontrolled glycemic group (n =158, 89.8%) incomparisontothecontrolledglycemic group (n =18, 10.2%).Ourresults showedthatT2DM was moreprevalent (145,78.7%)thanT1DM (39,17.3%)and GDM (9,4%) in uncontrolled DM than controlled DM .The women's show high spread of UTIs than men especially in uncontrolled DM than controlled DMthis was significant < 0.05 .The prevalence and the distribution of Gram- negative more than Gram-positive bacteria isolated from the clinical samples for both controlled and uncontrolled glycemia groups. *E.coli* (77,49.4%) was the dominant and significant in UTIs <0.01 The high prevalence of UTI confirms that uncontrolled DM is significantly associated with more UTIand regulation of glucose helped to reducing the complications and urinary tract infection. Diabetic patients especially uncontrolled women, are recommended to subuit mid-streamurinespecimens at regular intervals for cultureand routine investigations even the absence of any urinary tract symptoms

1 Introduction:

Diabetes Mellitus (DM) is a chronic metabolic disease associated with serious complications in various organs includingthekidney**(Giannakopoulos*etal,*2019,Al-Areqi *etal,*2022,Salari et al, 2022).**In2017, itwasestimatedthattherewere425millionpeoplewithdiabetesaged20-79year,whichispredictedtoriseto642millionin2040 .TheworldwideprevalenceofDMhasrisendramatically over thepast two decades **(Dave *et al* , 2018, International Diabetes Federation, 2018).**Bacterial UTIs are the second virulence factors, which play as asubsidiarypartinthe anatomicorfunction abnormalitiesinthekidney,bladder.The obstruction of collecting systems for normal urine flow include renal , ureteric , bladder calculi and benign prostatic hypertrophy,cysticrenal disease . In addition UTIs caused in specificdiseaselikeDM due to the abnormalitiesinhost defense mechanismsand these infections follow surgery or procedures that whichdoneinurinary tract**(Al-Ofairi *etal,* 2018,Aydin *et al,* 2020).**UTIsresultsfrom bacteria particularly that exist in the intestinal tract, vagina, nearby the urethra andthe ascension of the fecal derived organism from peri-urethral tissuesto the bladderand kidneys.These adherencetothebladderreceptorsitesandifthey possess thevirulencefactorsforpyelonephritistheyascendtheureterinthecontinuousfilmofurinethatreachtheureterto thekidneys **(Edrees and Anbar, 2020, Nwafia*et al,*2021).** Inwomentherearehigh incidenceofUTIs duringchildbearingageduetosexintercourseorthe use ofcontraception(e.g. diaphragmandspermicides). Especially,inelderlywomenpatientslossofestrogencausesa changeinthevaginalflora,lossoflactobacilliinthe vaginal flora , decreased bladder capacity and increased urine production,decreasedlowerurinarytractsensory and decreaseda voided volume that resulted in bacterial UTIs colonization**(Shah *et al,* 2019).** women patients had ahigher riskofurinarytractinfectionthanmalepatients .The cause ofhigherprevalenceofUTIamongwomenisthoughtto be due to anatomical predisposition comparedwith male . Womenhaveashortandwideurethrawithcloseproximity totheanus,allowing intestinalorganismseasieraccessto theurethra. Anotherpossible causemaybeduetochanges in physiological environment of the vagina among diabetic women, suchasdecreasesinnormalflora andalessacidic PH of the vaginal surface ,this may be exacerbated among women with poor hygiene **(Strome et al, 2019, Edrees and Anbar, 2020,Cela-Lopez et al, 2021, Moradi et al, 2021,Jain et al, 2022)**

The high prevalence of UTIs among DM patients, which attribute tovarious impairmentsinthe immunesystem (lowurinaryconcentrationof interleukin -8and interleukin -6, lower urinary leucocyte cell count). In addition, poor metabolic control and incomplete bladder emptyingdueto autonomicneuropathymayallcontributetotheenhancedriskof UTIsinthese patients **(Shah*etal,*2019, Al-Shammakh *et al,* 2019).** The differentbacterial specieshavebeencolonizingin theurinarytractofdiabeticpatientsduetoglycosuria that created a suitable environment for bacterial growth. Also,bladder dysfunctionanddepletionoflocal urinary cytokine secretion, depressed T–cell –mediated immune response,decreased production of prostaglandinE, thromboxane B2 and leukotriene B4 and depressed antioxidantsystems . DM isassociatedwithUTIsthroughitseffectonthehostimmunesystem especially in type 1 that is considered an autoimmune disease**(Shah*etal,* 2019,Jagadedsan*etal,*2022**). Inour country "Yemen", there is nopublisheddataabout the associationbetween UTIs and controlled and uncontrolled DM, therefor the present study has been conducted to explorethe incidenceof bacterial UTIsandassociatedrisk factors among patients of controlled and uncontrolled DMinSana'a City- Yemen. Thepresentstudyhasdesigned to: Detect the incidence of bacterial UTIs in controlled and uncontrolled DM patients in Sana'a City- Yemen, Determine the suitable antibioticssusceptibilityagainst bacterial UTIsincontrolledanduncontrolledDM patients,Exploretherelationshipbetweenbacterial UTIs and the main risk factorsin controlledand uncontrolledDMpatients .

2 MaterialandMethods:

StudyPopulation:urinesamplewerecollectedfrom 225 participants fromProf. Mohammed Bamashmous Internal Medicine,Republication Authorized Teaching,Al-Olaqi Specialized Laboratories and Baghdad Laboratoriesin Sana'a City, Yemen during the period between June 2022 to June 2023. Aquestionnaire was conducted for all participants and detailed information on demographic characteristics and other data related to UTIs and DM, was taken for each participants it is ethically approved.

UrineandbloodCollectionandProcessing: Taken 1.5ml of blood was collected in to EDTA tubes from all participants for determination of glycosylated hemoglobin

(HbA1c) and 3.5 ml of blood was collected in to serum tubes fromthemostparticipantsfor determinationofRBS,FBS,PPBS, Creatinine and Urea. Participants were instructed on How to collect clean catch midstream urine samples in to labeled sterile containers and immediately taken to the laboratory for urine analysis and urine culture .The urine culture carried out within 30 minutes from specimens collection to avoid contamination. The sample was processed by physical, chemical and microscopic examinationandculturedinCLED agar, Maconky agar and blood agar, after incubation the sample in 37^0C aerobicallywasproceedbyGramstainandbiochemicaltest .Finally spread partfrom suspension colony in Muller Hinton agar to determine susceptibility test.

identification of Isolated Microorganism: Count the approximate number of colonies estimate the number of bacteria,i.ecolony-formingunits(CFU)per mlofurine. Colonies warecountedonCLEDandmultipliedbytheloop volume. A bacterial count of (100.000) 10^5 per ml was consideredsignificantforUTI. Acountsbetween(100- 10.000)10^2-10^4permlwasconsideredassuspected /doubtfulbacteriuria . Whilecountslessthan(100)10^2per ml was considered no significant bacterial growth (contaminated)(Cheesbroth ,2006).UTIs isolate were identified following growth characteristics and biochemical test .Results were not considered for more two clinical isolate obtained from the same patients and the sample considered contamination .No-growth plates were considered as sterile. Biochemical tests were done for both Gram-positive and Gram negative.

SusceptibilityTest:

Antibiotic performed susceptibilitytesting on urine with bacteriuria, particularlyfrompatients witha history of recurring UTI.Antibiotic Susceptibility test was performed by the disc diffusion (Kirby-Bauer) method using Mueller-Hinton Agar .

agar for bacterial isolates. The sensitivity plates were incubated aerobically at 37ºC for 24hrs, and the zone of inhibition were recorded. A zone of inhibition greater than 15mm was considered as sensitive, a zone between 13 and 15 as intermediate, and a zone less than 13mm as resistant(**Cheesbrough, 2006).**

Statistical Analysis: The data were analyzed using a statistical package of social science program (SPSS, version21)andtheresults was presentedas percentages, mean, standard division, median and range . Chi-square X2 test was used for categorical variables and to determinesignificance in variable and UTIs.

3 Results:

Demographic characteristics : Ourstudy showed that thehigher older ages of DM patients werehigherthanother groups withthe meanrange of agegroupswas (37.86+15.84),also an uncontrolled DM patientswere higher than controlled DM ones withsignificant differences (P< 0.01), as showing inTable4.1 and4.2and Figures **4.1.** Our data showedthat DM is highlyincidence in women than men , especially in uncontrolled DM than controlledDMoneswithsignificantdifferences(P<0.01) , as showinginTables 4.1 and 4.2 and Figures The results showed that DM is highly incidence in long duration, especiallyinanuncontrolledDM thancontrolled DM ones with significant differences (P< 0.01).Our resultsshowedthatT2DMwas moreprevalentthanT1DM and GDM, with significant differences (P< 0.01).Our results body massindex(BMI)showed that werehigher in the case of an uncontrolled DM patients than in controlled DM ones , as showing inTables 4.1 and 4.2and Figures 4.1The results also showed that infections are more prevalent in Sana'a City Where it was more prevalencein the cases of uncontrolled DM patients than those who were controlled , then followed by the cities of Taiz and Hadramoot , Radaa, all of them showing significant in **Figure4.1.**

Table3.1DemographicCharacteristicsinControlledand Uncontrolled DM Patients

characteristics	controlled	uncontrolled	*P-value*
Age:	**N(%)**	**N(%)**	
13-19	7(14.2%)	10(5.6%)	
20-29	0(0%)	15(8.8%)	
30-59	28(57%)	94(53.3%)	P<0.01
>60	14(28.8%)	57(32.3%)	
Total	49(21.7%)	176(78.3%)	
Gender:	**N(%)**	**N(%)**	
Female	28(57.2%)	102(60%)	P<0.01
Male	21(42.8%)	74(40%)	
Total	49(21.7%)	176(78.3)	
DurationofDM:	**N(%)**	**N(%)**	
Oneyear	13(26.5%)	33(18.8%)	P<0.01
1-5years	10(20.4%)	42(23.8%)	
5-10years	11(22.5%)	33(20.4%)	
>10years	15(30.6%)	68(37%)	
Total	49(21.7%)	176(78.3%)	
Typeof DM:	**N(%)**	**N(%)**	
Type1	11(22.4%)	28(15.9%)	P<0.01
Type2	35(71.6%)	142(80.7%)	
GDM	3(6%)	6(3.4%)	
Total	49(21.7%)	176(78.3%)	
BMI:	**N(%)**	**N(%)**	
30-50	15(30.6%)	24(13.6%)	P<0.01
50-80	27(55%)	74(42%)	
80-100	7(14.4%)	75(42.7%)	
100-120	0(0%)	3(1.7%)	
Total	49(21.7%)	176(78.3%)	

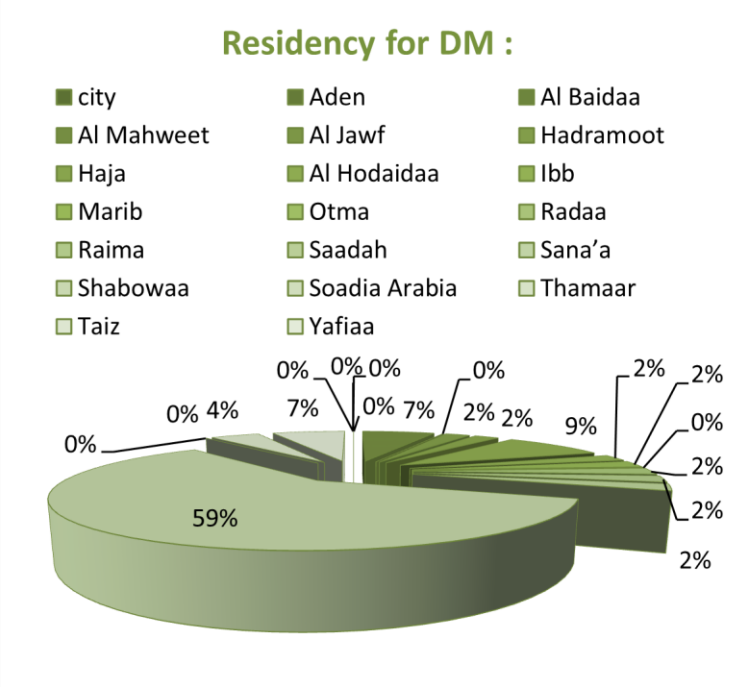

Figure3.1TheResidencyforControlledandUncontrolled DM Patients

Symptoms and ASB in DM Patients : The symptoms waremorespread in uncontrolled DM thancontrolled DM and the ASB (108,48%),urgency (88,39.1%) Burning (77,34.2%) frequency (72,32.0%) dysuria (60,26.7%)Supra-pubic pain (49,21.8%)itching(60,26.7%)incontinous(38,16.9%)flank pain(56,24.9%) fever(22,9.8%) hematuria(5,2.2%)discharge (11,4.9%)vomiting(11,4.9%)chills(2,0.9%)intable3.2.

Complication in DM Patients : The study also showed higher prevalence in complication of DM in uncontrolled DM comparedwithcontrolledDM andtheperipheralneuropathyis themoreprevalence(186,82.7%),retinopathy(125,55.6%) obesity(99,44%)incompletebladder(88,39.1%)cholesterol (67,29.8%)nephropathy(24.0%)cardiovascular(51,22.7%) hypertension(81,36%)prostatesyndrome(18,8.0%)

Risk Factors: The results showed the risk factors and the more effect is the diet, insurance statusphysical activity , showing qhat ,tobacco consumption these ware higher in uncontrolledDMcomparedincontrolledDMalsoeducation andtherapy haverelationship withuncontrolledDMall of the factors in respectably were significant **in table 3.4**

Table3.2prevalenceofsymptomsofUTIincontrolledand uncontrolled DM patients

Symptoms	Controlled	Uncontrolled	P. value
ASB	N(%)	N(%)	
YES	23(47%)	85(48%)	P<0.01
NO	26(53%)	91(52%)	
Total	49(21.7%)	176(78.3%)	
Symptoms:			
Dysuria:	N(%)	N(%)	
Yes	10(20.4%)	50(28.4%)	
No	39(79.6%)	126(71.6%)	
Total	49(21.7%)	176(78.3%)	
Urgency:	N(%)	N(%)	
Yes	17(34.6%)	71(40%)	P<0.01
No	32(65.4%)	105(60%)	
Total	49	176	
Frequency:	N(%)	N(%)	
Yes	10(20.4%)	62(36.4%)	P<0.01
No	39(79.6%)	114(63.6%)	
Total	49(21.7%)	176(78.3%)	
Burning:	N(%)	N(%)	
Yes	13(26.6%)	64(36%)	P<0.05
No	36(73.4%)	112(64%)	
Total	49	176	
Hematuria:	N(%)	N(%)	
Yes	2(4%)	3(1.7%)	
No	47(96%)	173(98.3%)	
Total	49(21.7%)	176(78.3%)	
Suprapubicpain:	N(%)	N(%)	
Yes	5(10.2%)	44(25%)	
No	44(89.8%)	132(75%)	
Total	49(21.7%)	176(87.3%)	
Vomiting:	N(%)	N(%)	
Yes	0(0%)	11(4.%)	P<0.05
No	49(100%)	165(93.7%)	
Total	49(21.7%)	176(78.3%)	
Fever	N(%)	N(%)	
Yes	0(0%)	22(12.5%)	P<0.01
No	49(100%)	154(87.5%)	
Total	49	176	
Discharge:	N(%)	N(%)	
Yes	1(2%)	10(5.7%)	P<0.01
No	48(98%)	166(94.3%)	
Total	49(21.7%)	176(78.3%)	
Incontinous:	N(%)	N(%)	
Yes	6(12.2%)	32(18.1%)	P<0.05
No	43(87.8%)	144(81.9%)	
Total	49	176	
Itching:	N(%)	N(%)	
Yes	9(18.3%)	51(28.9%)	
No	40(81.7%)	125(71.1%)	
Total	49(21.7%)	176(78.3%)	
Flank pain:	N(%)	N(%)	
Yes	11(22.4%)	55(31.2%)	P<0.05
No	38(77.6%)	121(68.8%)	
Total	49(21.7%)	176(78.3%)	
Chills:	N(%)	N(%)	
Yes	0(0%)	2(1.1%)	
No	49(100%)	174(98.9%)	
Total	49(21.7%)	176(78.3%)	

Table3.3prevalenceofcomplicationsincontrolledand uncontrolled DM patients

Complication	Controlled	Uncontrolled	P.value
Incomplete bladder:	N(%)	N(%)	
Yes	14(28.5%)	74(42%)	P<0.01
No	35(71.5%)	102(58%)	
Total	49(21.7%)	176(78.3%)	
Prostate syndrome:	N(%)	N(%)	
Yes	6(12.2%)	12(6.8%)	P0.01
No	43(87.8%)	164(93.2%)	
Total	49(21.7%)	176(78.3%)	
Hypertension:	N(%)	N(%)	
Yes	14(28.5%)	67(38%)	P<0.01
No	35(71.5%)	109(62%)	
Total	49(21.7%)	176(78.3%)	
Obesity:	N(%)	N(%)	
Yes	12(24.4%)	87(49.4%)	P<0.01
No	37(`75.6%)	89(50.6%)	
Total	49(21.7%)	176(78.3%)	
Cardiovascular:	N(%)	N(%)	
Yes	7(14.2%)	44(`25%)	
No	42(85.8%)	132(75%)	
Total	49(21.7%)	176(78.3%)	
Nephropathy:	N(%)	N(%)	
Yes	6(12.2%)	48(27.2%)	P<0.01
No	43(87.8%)	128(72.8%)	
Total	49(21.7%)	176(78.3%)	
Neuropathy:	N(%)	N(%)	
Yes	14(28.5%)	65(36.9%)	P<0.01
No	35(71.5%)	111(63.1%)	
Total	49(21.7%)	176(78.3%)	
Cholesterol:	N(%)	N(%)	
Yes	9(18.3%)	58(33%)	P<0.01
No	40(81.7%)	118(67%)	
Total	49(21.7%)	176(78.3%)	
Peripheral:	N(%)	N(%)	
Yes	31(63.2%)	155(88%)	P<0.01
No	18(36.8%)	21(12%)	
Total	49(21.7%)	176(78.3%)	
Retinopathy:	N(%)	N(%)	
Yes	22(45%)	103(58.5%)	P<0.01
No	27(55%)	73(41.5%)	
Total	49(21.7%)	176(78.3%)	

Check of DM : HbA1c,FBS, RBS, PPBS, Creatinine, and Urea ware more higher in uncontrolled DM than controlled DM andnoappearanysignificantorrelationshipwithUTIs themean was for all in **table 3.5.**

Table3.4RiskFactorAffectedinControlledandUncontrolled DM Patients

Risk factors	Controlled	Uncontrolled	P. value
Diet:	N(%)	N(%)	
Yes	29(59%)	13(7.3%)	P0.01
No	20(41%)	163(92.7%)	
Total	49(21.7%)	176(78.3%)	
physicalactivity:	N(%)	(N%)	
Yes	40(82%)	62(46%)	P<0.01
No	9(18%)	114(64%)	
Total	49(21.7%)	176(78.3%)	
qhatchowing:	N(%)	N(%)	
Yes	10(20.4%)	123(69.8%)	P<0.01
No	39(79.6%)	53(30.2%)	
Total	49(21.7%)	176(78.3%)	
tobacco consumption:	N(%)	N(%)	
Yes	6(12.2%)	61(34.6%)	P<0.01
No	43(87.8%)	115(65.4%)	
Total	49(21.7%)	176(78.3%)	
Insurancestatus:	N(%)	N(%)	
Yes	9(18.3%)	10(5.6%)	
No	40(81.7%)	166(94.4%)	
Total	49(21.7%)	176(78.3%)	
Materialstatus:	N(%)	N(%)	
Married	30(61.2%)	121((68.7%)	P<0.01
Unmarried	10(20.4%)	18(10.2%)	P<0.05
Widow	9(18.4%)	37(21.1%)	
Total	49(21.7%)	176(78.3%)	
Education:	N(%)	N(%)	
Above	0(0%)	3(1.7%)	
Graduate	9(18.3%)	13(7.3%)	P<0.01
Highsecondary	3(6.3%)	7(3.9%)	P<0.01
Secondary	10(20.4%)	33(18.7%)	P<0.01
Primary	14(28.5%)	50(28.4%)	P<0.01
Illiterate	13(26.5%)	70(40%)	
Total	49(21.7%)	176(78.3%)	
Thereby:	N(%)	N(%)	
Insulin	13(26.5%)	35(20%)	P<0.01
Insulinplusoral	7(14.2%)	27(15.3%)	P<0.05
antidibetesOral	27(55.3%)	95(54%)	P<0.01
antidibetes	2(4%)	19(10.7%)	P0.01
Without	49(21.7%)	176(78.3%)	
Total			

Chemical Examination and UTIs: The result also showed that in the case of the chemical test, the presence of nitrite, protein, blood and lucocyte indicates the presenceof infections, and also the presence of glucose was an indicator of thecase of highandtheappearance of sugar intheurine in the chemical test .Likewise, the protein was the same thing that affected in uncontrolled DMpatients , while its appearance was less and was almost negligible in the case of diabetes's patients in **table 3.7.**

Table3.5CheckforDM Patients

characters	N	Mean_+SD	P Value	95%confidence interval	
HbA1c:	225	8.8+4.1	<0.01	Lower bound	Upper bound
				0.000	0.21
FBS:	156	190+89	0.7	0.923	0.979
					0.999
RBS:	47	205.49+136.6…and the median .140	0.9	0.965	
PPBS:	144	297.7+124.5	0.5	0.482	0.612
Cerat inine:	141	0.9055+0.873…… andthe median .0.8	0.7	0.719	0.828
Urea:	140	28.50+11.5	0.2	0.230	0.348

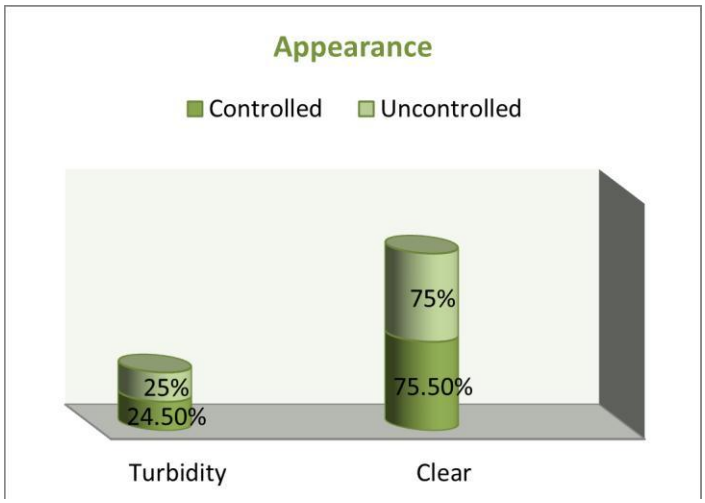

Figure3.6ThePhysicalExaminationinControlledand Uncontrolled DM Patients

Microscopic Examination and UTIs: The results also showed that the microscopic test indicates the presence of urinary infections, especially WBC, RBC, Epithelial Cell, Mucus, Bacteria and Yeast, whereall of these ware morein the case of uncontrolled DM patients than the controlled DM and since the increase in the most of them, bacterial growth was found after culturing thesamples that including more than one of them and ware strong relationship was found in all of the above.while there was no relationship in the rest such as cast, *Schistosoma*in **table.3.8** .

Table3.7ChemicalExaminationinDMPatients

Chemical examination	DM	Pvalue
PH:	N(%)	P0.3
Acidic	205(91.1%)	
alkaline	20(8.9%)	
Specific gravity: Mean +SD	2.38+11.8	P0.8
Blood:Mean+SD	2.71+0.75	P0.06
Nitrite: Mean+ SD	2.56+0.66	P0.2
Protein: Mean+ SD	2.81+0.84	P0.1
Glucose: Mean+SD	3.59+0.71	P0.3
Ketone:Mean+SD	2.86+0.82	P0.07
Bilirubin: Mean +SD	3.0+0.89	P0.3
Urobillurbin: Mean+ SD	2.83+0.57	P0.05

Table3.8.MicroscopicExaminationinDMPatients

Microscopicexamination	DM Mean+SD	Pvalue
WBC:	7.50+5.59	P<0.01
RBC:	2.22+2.39	P0.01
EpithelialCell:	2.14+0.76	P<0.01
Crystals:	3.14+1.04	
Mucas:	2.09+7.6	P<0.01
Cast:	N(%)	
Seen	7(3.1%)	
No	218(96.9%)	
Bacteria:	N(%)	P<0.05
Seen	20(8.9%)	
No	205(91.1%)	
Amorphous:	3.14+1.04	
Yeast:	N(%)	P<0.05
Seen	9(4%)	
No	216(96%)	
Parasiteova:	N(%)	
S.heamatubium	3(1.3%)	
E.vermicularius	1(0.4%)	

Study Population: This study was conducted on urine samplesfrom225diabeticpatientsduringtheperiodbetween July 2022 and December2022. Amongthe225 analyzed samples, 49 (21.8%) were showing sterile urine samples, while 9 (4.0%) showed mixed growth of bacteria possiblydueto improper collection ofthesample.Theremaining122 (54.2%) samples werepositive(significant)with colony count 10^5CFU|ml, 34 (15.1%)warepositive(suspected) with colony count 10^3-10^4CFU\ml , 11 (4.9%)ware non-significant with colonycount-less than$10^2$for uropathogens**intable 3.8 .**The studied population was classified according to the glycemic status; patients with controlled glycemia (HbA1c < 6.5) and patientswith uncontrolled glycemia (HbA1c ≥ 6.5) .The number of subjects with UTI was clearly higher in the uncontrolled glycemic group (n =158, 89.8%) in comparison to the controlled glycemic group (n =18, 10.2%).

In the addition the UTI was higher in T2 than other T1 and GDM in uncontrolled DM than controlled DM The women's show high spread of UTIs than men especially in uncontrolled DM 106than controlled DM 25 this was significant 0.013 but the man's show low UTIs in status uncontrolled DM 74 and in controlled DM was just 21 and this was significant< 0.05 **in Figure3.9**

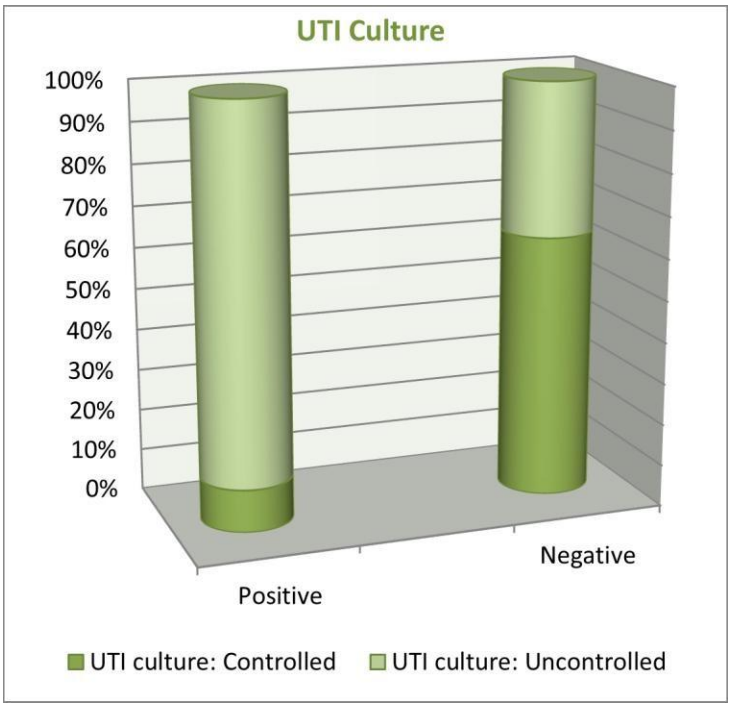

Figure3.4 UTIinDM Patients

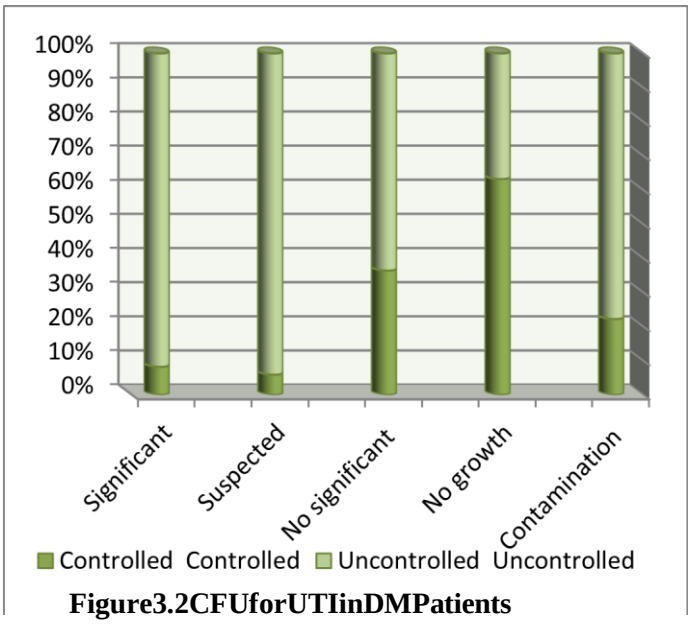

Figure3.2CFUforUTIinDMPatients

The prevalence and the distribution of Gram-negative more than Gram-positive bacteria isolated from the clinical samples for both controlled and uncontrolled glycemia groups. These isolates from both females and males represented clinically significant pathogens. *E.coli* (77,49.4%) was the dominant and significant in UTIsP<0.01 after that was *K.pneumoniae*(17,10.8%) *S.auerus* (13,8.8%),*P.aeroginosa*(10,6.4%)P.mairabilus(8,5.1%) *Citrobacter*(5,3.2%)St.aglactiae(5,3.2%)S.saprophyticus (4,2.5%)*P.valgarius*(3,1.9%)K.otherSp(3,1.9%)*St.other pneumoniae*(1,0.6%)*St.pyogens*(1,0.6%)allthesenoshow any significant

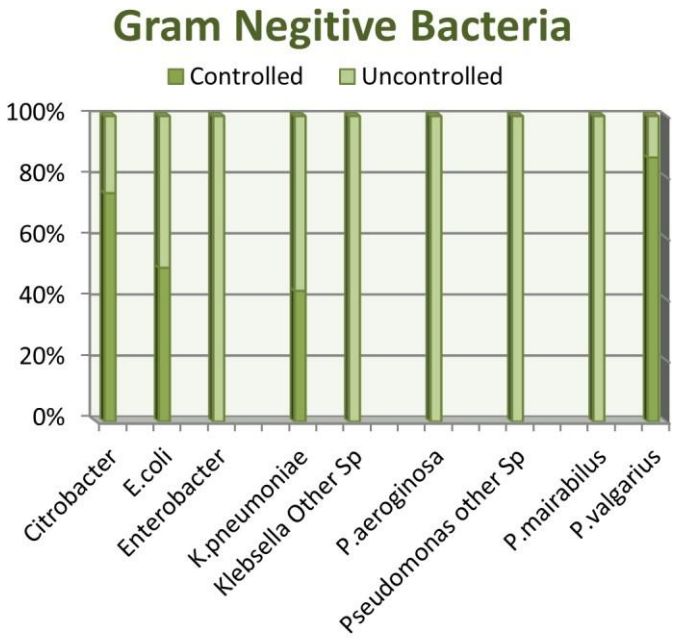

Figure 3.5 Gram Negative Bacteria in DM

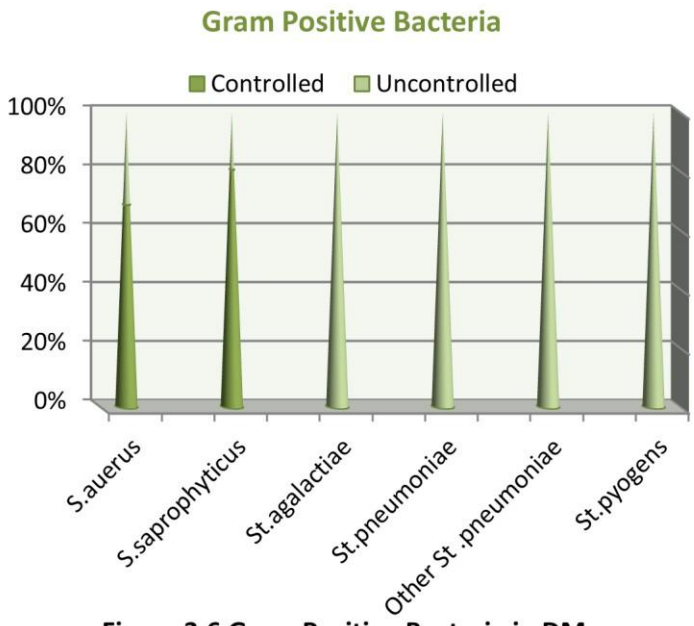

Figure 3.6 Gram Positive Bacteria in DM

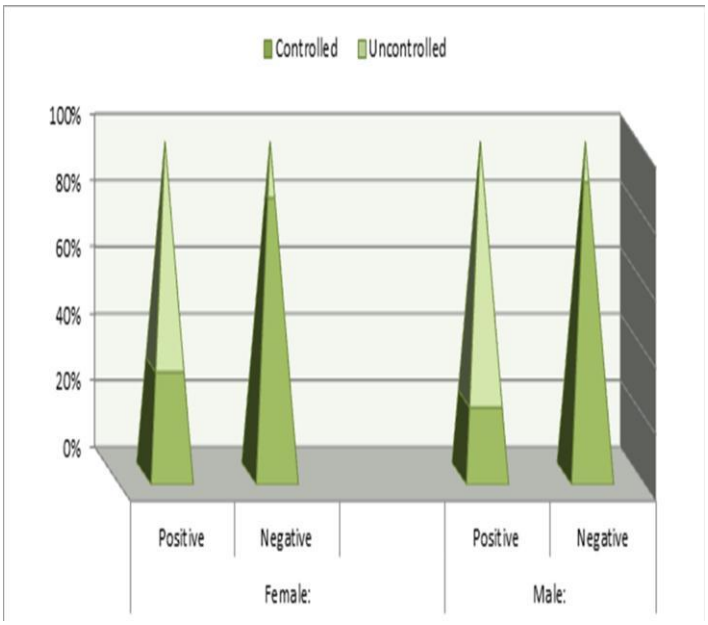

Figure3.7UTIsmoreinFemalethanMale

AntibioticsforUTIinDMPatientsUTIs:

Theresults alsoshowed moreresistant toantibiotics in all uncontrolled and controlled DM patients GEN(52.4%)AK(41.3%)NIT(40.9%)DOX(29.8%) CIP(29.3%)COT(27.6%)VAN(24.9%)CD(24.9%) CAZ(18.2%)AMC(17.3%)E(16.0%)AMX(14.2%) AS(12.9%)AZM(11.1%)CFM(4.2%)

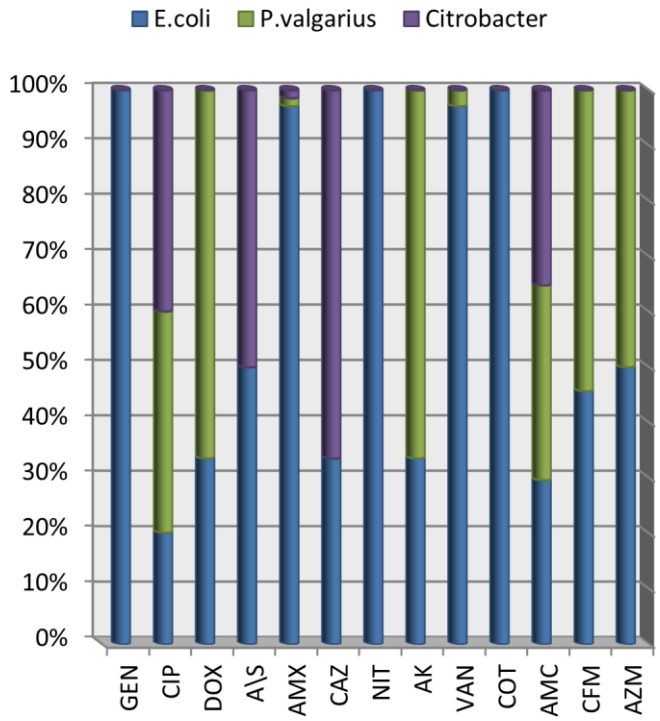

Figure3.8AntibioticsResistantinGramNegativein Uncontrolled DM Patients

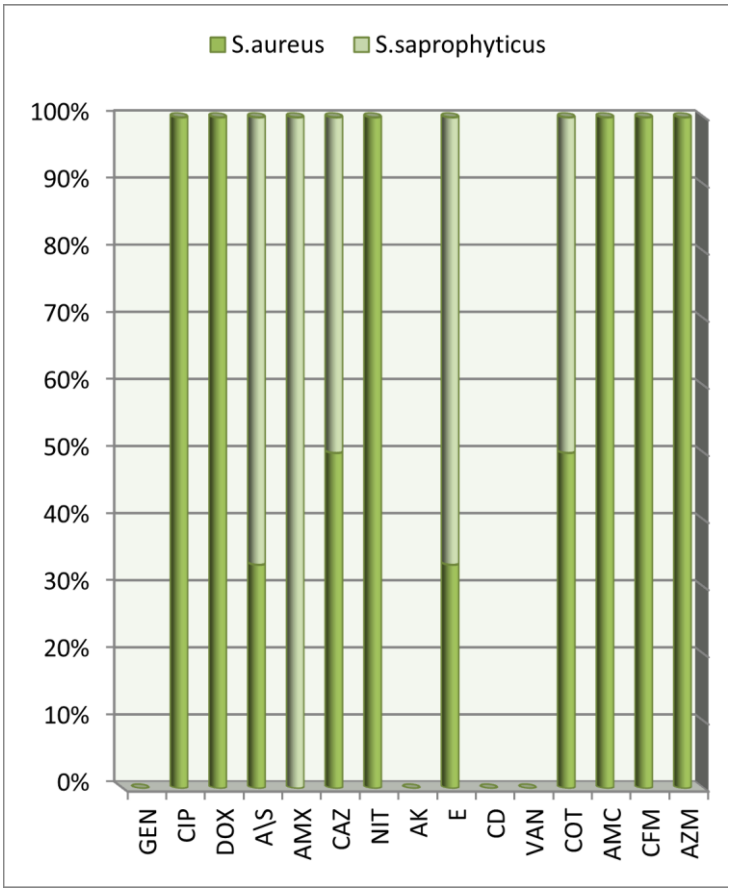

Figure3.9AntibioticsResistantinGramPositivein UncontrolledDMPatients

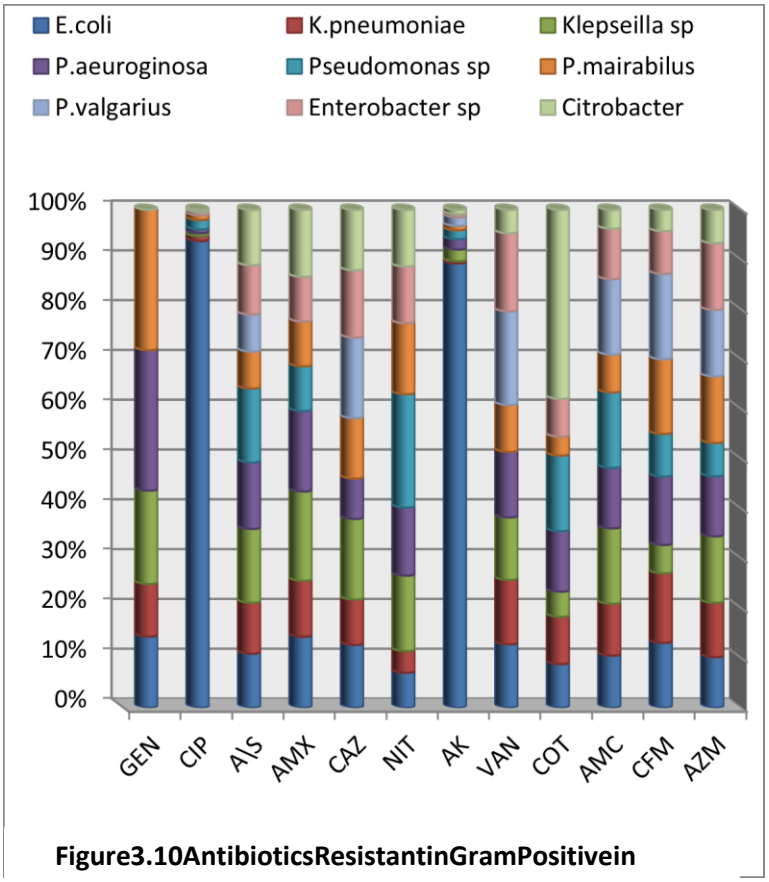

Figure3.10AntibioticsResistantinGramPositivein Uncontrolled DM Patients

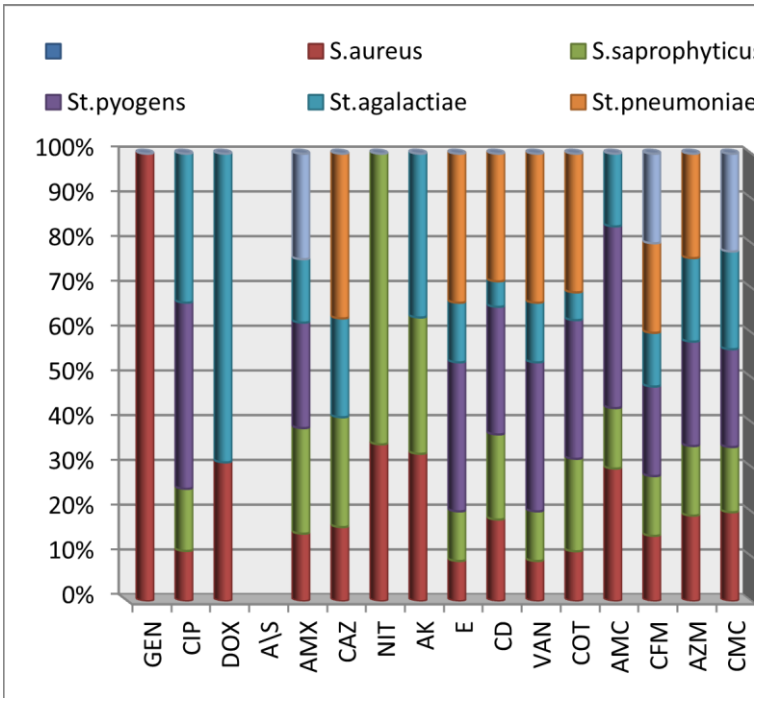

Figure3.11AntibioticsResistantinGramPositivein UncontrolledDMPatients

4. Discussion:

The study showing higher of UTI in older age and the mean range of age was (37.86+15.84) also its higher in uncontrolled DM than controlled DM this was significant 0.0001 this agree with **(Muthulakshmi and Gopalakrishnan, 2017, Al–Ofairy *etal*,2018)**and dis agree with **(Swify *et al,* 2016,Ahmed *et al,* 2020, Edrees and Anbar,2020).**Also the duration of DM especially in duration higher than 10 years showedHigh spread of UTIs in status uncontrolled DM and few in controlled DM 74 (32%) this is was significant 0.0001this agree with(**Swify *etal,* 2016, Al-Ofairy *etal,* 2018, Dave*etal,*2018,)**butthiswasdisagreewith**). (Ebidor *et al,*2015,Dave *et al,*2018,Ahmed*et al,* 2020).** because the susceptibility of DM patients could be explained by diminished neutrophil response, lower urinary cytokines, and leukocyte concentration which might facilities the adhesion of microorganisms to uroepthilial cellOur results showed that T2DM was more prevalent than T1DM and GDM. observed the UTI more and significant in Type 2 and GDM**(0.0001,0.003) respectably (Shah and Paracha, 2016, Al-Ofairy *et al,* 2018 Shah *et al,* 2019,Desouky *et al,* 2020).** These results were similar with other reports which illustrated that DM is the comments' metabolic diabetes constituting nearly 90% of the diabetes population**.**Our results also showedthat highweight from50-80 andfrom80-100 was significant on UTIsaffects the regulation of sugar and was higher in the case of uncontrolled DM than in controlled DM, while this agree with**(Desouky *et al,* 2020)** and dis agreewith**(Swify *etal,* 2016)**Whoshowed no relationship between weight and UTI. The results also showed that infections are more prevalent in the city of Sana'a ,Where it was more prevalent in the cases uncontrolled than those who were controlled , then followed by the cities of Taiz and Dhamar and all these cities showed a significant relationship 0.001,0.02,0.01 respectivelythis maybe because the study was in Sana'a City and the most of patients from Sana'a City. The symptoms ware more spread in uncontrolled DM than controlled DM , urgency ,Burning ,frequency, dysuria , Supra-pubic pain , itching , incontinous . this agree with **(Muthulakshmi and Gopalakrishnan , 2017,Anejo- Okopi *etal,* 2017 ,Dave *etal,* 2018, Shah *etal,* 2019).** but this dis agreewith (Al-Ofairy et al 2018, Gomez- Ochoa and Vega-Vera, 2019,Al-Baghdadi *et al*, 2021) Who wereshowed that the asymptomatic (ASB) bacteriuria were the most common infection in diabetic patients.

Allthese warehigher thanother typeofsymptoms of UTIsmay be because bladder is a store house for urine .Uropathogens can enter and colonize in bladder much easier than other part of urinary tract system flank pain , fever , hematuria , discharge , vomiting , chills this may be symptoms when the uropathogen reach in to kidney.Our study also showed higher prevalence in complications of DM in uncontrolled DM compared with controlled DM and the peripheral neuropathy is the more prevalence(186,82.7%) , then retinopathy (125,55.6%) obesity (99,44%) **(Sweify *et al*,2016, Dave *et al*,2018,Al- Shammakh *et al*,2019).** Obesity might be considered as a cofounder in the correlation between glycemic control and UTI as obesity rates areabout (99, 44 %) in our study this agree with **(Seweify*etal*,2016).**Nephropathy(54,24.0%) cardiovascular(51,22.7%)hypertension(81,36%)prostate syndrome (18,8.0%) incomplete bladder (88,39.1%) cholesterol (67,29.8%).Also the study showed the risk factors effect in controlled DMand have related with UTIs is the diet (18.3%) was significant 0.0001, physical activity(45.3%) was significant 0.0001 and showing qhat (59.1%) was significant 0.01 ,tobacco consumption(29.8%) was significant 0.002, insurance status (8.4%) was significant 0.004, material statuswas significant , these ware higher in uncontrolled DM compared in controlled DM and wereall ofthemsignificant .This agreewith **(Anejo-Okopi *etal*,2017, Saghir*etal*, 2019)**.Our resultsshowedthat in the case of treatment in patients with diabetes, oralantidibetes, oral antidibetes are more used than others, followed by insulin. A strong relationship was also found in the case of education,as the percentage of illiterate persons reached 70 in the case of non-member, while those who joined were 13, and the total percentage was 36.9% followed by primary with a percentage of 64 (28.4%) this agree with (**Sweify *et al*, 2016, Dave *et al*, 2018).** Predisposing conditions to urinary tract infection were renal calculi, older age female gender, high glucose in bloodand the main factors increasing the susceptibility of UTIs in Yemen comparing with developed countries were that large of patients with DMand self- monitoring and follow up for check and adjust treatment in Patients is low or absent . in addition, there were highoccurrence of possible co- existent factors that increase the susceptibility to contract UTI among patients of those, personal hygiene, sexual practices and water intake **(Anejo-Okopi *et al*, 2017,Dave *etal*, 2018,Giannakopoulos *etal*, 2019, Storme *et al*, 2019,Jagadeesan *et al*, 2022).**FBS, RBS, PPBS, Creatinine, and Urea and the mean and stander deviation for all ofthemware(190+89,205.4+136.6,297+124,0.9+0.8,28.5+11.5) their ware more higher in uncontrolled DM than controlled DM and no appear any significant or relationship with UTIs the meanwasfor allthisagreeto**(Shahand Paracha, 2016, Al-Ofairy *etal*, 2018)** and dis agree with **(Desouky *etal*, 2020).**HbA1c (8.8+4.1) was significant 0.004 to UTIsthis agree to**(Shah *et al*, 2019,Desouky *et al*, 2020, Ahmed *et al*, 2020)**, Also the study show the physical examination for urine analysis the yellow, orange(0.0001,0.0001) respectably and more spread in patients with DM in all uncontrolled and controlled DM this agree with **(Parida *et al*, 2018)** may be the normal color ranges from yellow to orange and this result of the pigment called urochrome, however disease states can cause the color of urine to change from normal color extremes. Our result also showed that in the case of the chemical test, the presence of nitrite, that observed markedly in the samples from which Gram –negative bacterialike*E.coliK.pneumoniae*and*proteusspp*areable to reduce nitrate present in urine to nitrite this agree with **(Parida *et al*, 2018)** , protein, blood, leukocyte in state of exist of pus or WBC in urinethat indicateto inflammation may be bacterial or other inflammation , and also the presence of glucose was an indicator of the case of high and the appearance of sugar in the urine and in this status we observed yeast in microscopic examination**(Parida *et al*, 2018).** That affected in uncontrolled DMpatients , while its appearance was less and was almost negligible in the case of controlled patients in**(Gomez - Ochoaand Vega - Vera, 2020, Shah and Paracha, 2016).** Glucoseuria was also found to be associated with UTI this agree with **(Swaify *etal*,2016, Alsamarai *etal*, 2016,Al Ofairy *et al*, 2018)** .diabetic patientsmay be appeared to be at a higher risk for colonization with the virulentmake suitable environment for adhesion of uropathogens and genetal infectionin uroepthilial celland promote colonization and invasion **.** The microscopic examination ofurineshowed that the whitebloodcell (WBC),redblood cell (RBC),epithelial cell, mucus, , bacteria, yeast, was significant in all of them(<0.0001,0.01,0.0001,0.0001, crystals,0.004,0.004) respectelly crystals,*Schistosma haematobium ,Entrobius vermicularis* increased in uncontrolled DM than controlled DM and they found a heavy and appreciable bacterial growth in patients with bacteriuria this agree to **(Shah and Paracha , 2016,Al Ofairi *et a,l* 2018, Parida *et al*, 2018 , Al-Shammakh *et al*, 2019, Awosolu *et al*, 2020, Taghipour *et al*, 2020).** Generally, urine is considered sterile and germ free different studies found that most uropathogens responsible for UTIs colonize the colon and perianal region .

Faucalpathogensthat ascendwiththeopeningofurethra,stick to the wall of urethra, multiply and move up towards bladder and causing signs and symptoms. Pathogenesis can be ascending or haematogenous rout this agree with **(Shah *et al*, 2019).**DM is a metabolic disorder resulting from a defect in insulin secretion or insulin action or both leads to chronic hyperglycemia **(Al Ofairy*et al,* 2018).** In the present study, we investigatedthepossible impact of the glycemic control on the UTI prevalence, antimicrobial **drugs** susceptibility in diabetic patients and complications andrisk factors in patients in controlled anduncontrolled DM.Our main findings arethe following there is much higher prevalence of UTI in diabetic patients withuncontrolledglycemia, theglycemiccontroldoes affect the distribution of UTI according to agethis finding agree with **(Coronel *etal,* 2015,Seweify *etal,* 2016, Ahmed *et al* , 2020,Dave *et al,* 2018, Shah *et al* ,2019).**DM attribute various impairment in the immune system (low urinary concentration of interleukin-8 and interleukin-6, lower urinary leucocyte cell count and granulocyte dysfunction possiblybecause of abnormal intracellular calcium of immune cell)poor metabolic control and incomplete bladder empting due to autonomic neuropathy may all contribute to the enhanced risk of UTI in DM UTI are documented as an inflammatory response of the uro-epitheium by bacterial invasionthat areusuallyassociated withbacteriuria andpyuria **(Nitan *et al,*2015, Shah *et al,*2019, Mamo *et al* , 2019, Jagadedsan *et al,* 2022).**Our results show that UTIs in female(61.9%) more than in male(38.1%)and this was significant 0.004 this agree with **(Shah and Paracha, 2016, Obeagu*etal,* 2016, John*etal,2016,Al-Ofairietal,2018, Parida et al, 2018, Shah et al,2019)and dis agree with *(Ahmedetal,2020)***WhoshowedthemanmorepronetoUTIs than women . In terms of gender, females are more prone toget UTIthan males .Women arevulnerableto UTIduetotheir anatomy and reproductive, physiology, short urethra,urethra closer to perirectal area where pathogen colonies easier, absence of bacteriostatic prostatic secretion and sexual intercourse. Gram negative bacteria are more commonly causing UTI than gram positive bacteria **.***E.coli* remains the most common etiological agent of UTIs . *E.coli* is bacteriumof the digestive tract. It can spread, especially , in women for anatomical reasons: down to the anus and then back in the urinary tract by multiplying and causing UTIs . This agreewithmanystudies**(Sewify*et al,*2016,AlOfairi*etal,*2018, Dave*etal,*2018,,Shah*etal*2019,Ahmed*etal,*2020).**

This was dis agree with**, (Patnaik *etal,* 2017).** Who reported that the most frequent bacterial infection is caused by *K.pneumoniae*and(Sweify *et al* ,2016) that Who report that *t*he *Candida albinans* this differentiate because we don't culturefungiinourstudy.Gram-negativestrainsincluding *E. coli*predominant because thebacterial factors comprise the type 1 fimbriae which are present in all E. coli strains and probably have a role in promoting initial colonization and other bacterialfactors contributetothepathogenicityin diabetes mellitus this maybeduetothemajorityof diabetic patients in this investigation take anti-diabetic drugs regularly which may reduce their susceptibility and second was*K.pneumoniae*wereagreement withpreviousreported studies **(Alsamarai*etal,*2016,Ahmed *etal,*2020,Shah *et al,* 2019).** The study also showed more resistant to antibiotics in all uncontrolled and controlled DM patients GEN(52.4%)AK(41.3%)NIT(40.9%)DOX(29.8%)CIP (29.3%)COT(27.6%)VAN(24.9%)CD(24.9%)CAZ (18.2%)AMC(17.3%)E(16.0%)AMX(14.2%)AS(12. 9%)AZM(11.1%)CFM(4.2%)CMC(1%)Indeed,high resistance to this first-line antibiotic is of big concern to clinicians in Yemen and other alternatives should be developed antibiotics resistance among bacteria in ourstudy is may be due to several reasons including the wide use of antibiotics by patients themselves (self-treatment), the blind treatment (prescribe antibiotics by physicians without antibiotics sensitivity test)**(Swify *et al,*2016, Angoti *et al,* 2016,Mazzariol *et al,* 2017, Ahmed *et al,* 2020).** Enterococciexhibitintrinsicandacquired resistance to various antibiotics such as *Beta*-lactams, aminoglycosides, macrolides, lincosamiddes, cotrimoxazole, glycopeptides, associated with mobile geneticelementsorchromosomalexchangeandmutation**(Gian nakopoulos*et al,*2019, Miguel et al, 2020).**

5. Consolation and Recommendation : These findings add further evidence to the importance of tighter glycemic control in reducing the occurrence of UTI and most probably improving the clinical outcome. UTI are more frequent and are likely to have a more complicated coursein DM patients .The high prevalence of UTI confirms that uncontrolledDMissignificantlyassociatedwithmoreUTI . The prevalence among female was higher than males in uncontrolled DM than controlled DM.Regulation ofglucose helped to reducing the complications and urinary tract infection. Common conditions predisposing to UTI in DM were diet, physical activity, qhat chowing, tobacco consumption, insurance status were significantly that leading to increasing the glucose in the blood as UTI. Symptoms more frequent than Asymptomatic The symptoms ware more spread inuncontrolled DM than

controlled DM. The prevalence and the distribution of Gram-negative more than Gram-positive bacteria isolated from the clinicalsamples for bothcontrolledanduncontrolledglycemia groups.*E.coli* remains the most common etiological agent of UTIs . *E.coli* is bacterium of the digestive tract. The studyalso showed higher prevalence in complication of DM in uncontrolled DM compared with controlled DM and the peripheral neuropathy is the more prevalence. More resistantto antibiotics in all uncontrolled and controlled DM patients andthe cause maybe is randomly usedto antibiotics.Diabetic patients especially uncontrolled women, are recommended to subuit mid-stream urine specimens at regular intervals for culture and routine investigations even the absence of any urinary tract symptms. Screening of urine samples for antimicrobial sensitivity while initiating the course of treatment among al UTI cases to check for and prevent resistance . Glucose control with regular check and therapy dose have impact on the episode of UTI.

Acknowledgement:

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