Ethiopian Medical Journal 2023, 61(1)
Open access articles distributed in terms of
Creative Commons Attribution Licence [CC by 4.0]
ISSN 0014-1755 eISSN 2415-2420 Ahmed et al

Original Article

Prevalence and drug susceptibility pattern of urinary tract infections among war disabled patients of Denden Hospital, Asmara, Eritrea

Khawaja Shakeel Ahmed [1,2,3 *], Kinfe Tewelde[2], Packianathan Danial Thomas[2], Samsom Fisehatsion[2], Yitbarek G/ Her[2], Abera Kumalo Shano[3], Takele Teklu Anijajo[3,4]

[1]Department of Medical Laboratory Sciences, College of Medicine, Komar University of Science and Technology, Sulaymaniyah, Kurdistan, Iraq
[2]Department of Clinical Laboratory Sciences, Asmara College of Health Sciences and Medicine, Asmara, Eritrea
[3]Medical Laboratory Science Department, College of Health Sciences and Medicine, Wolaita Sodo University, Wolaita Sodo, Ethiopia
[4]Immunology and Molecular Biology Department, University of Gondar, Gondar, Ethiopia

Corresponding author*: khajashakeel@gmail.com

Abstract

Background: *Urinary Tract Infections (UTIs) are the most common bacterial infections. The objective of the study was to assess UTI prevalence, common bacterial pathogens responsible for UTI, and the drug susceptibility pattern of bacteria towards commonly used drugs for UTI treatment among war-disabled patients admitted to Denden Military Hospital, Asmara, Eritrea.*

Methods: *A prospective cross-sectional study was conducted among 236 war veterans who were disabled during the war and took treatment at Denden Military Hospital.Midstream urine samples were collected in culture bottles. All collected urine samples were then cultured on different bacteria culture media. Biochemical tests were performed on posi-tive urine cultures based on significant bacteriuria as per the Kass count (>10^5 organisms/mL). Antimicrobial susceptibility tests were performed to analyze the resistance/ susceptibility pattern. Statistical Package for Social Services, version 20.1 was used for data entry and analysis.*

Results: *The overall prevalence of UTI was 81.7% (193/236). The common isolates were Escherichia coli (E.coli) 73(36.8%) followed by Staphylococcus aureus (S. aureus)38(19.1%). Usage of catheters with culture positivity was 22 (95.6%), 58 (95%), and 38(90.4%) for suprapubic, Condom, and Urethral Catheters, respectively. The antibiogram showed 62(84.9%) isolates of E.coli were resistant to Nitrofurantoin, while Staphylococcus aureus was found resistant to Tetracycline 25 (65.7%).*

Conclusion: *The results showed that most of the disabled patients included in the study were infected with UTI, and the most common pathogen isolated was E. coli followed by S. aureus. Based on the antimicrobial susceptibility test, the drug of choice for Gram-negative bacteria can be Amikacin, Gentamycin, and Cefalexin. While for Gram-positive bacteria it can be Ampicillin.*

Keywords: *Eritrea, War Disabled, Asmara, Urinary Tract infection. Antimicrobial Susceptibility pattern, Denden Hospital.*

Citation: *Ahmed KS, Tewelde K, Thomas PD, et al , Prevalence, and Drug Susceptibility Pattern of UrinaryTract Infections among War Disabled patients of Denden Hospital, Asmara, Eritrea .Ethiop Med J 61 (1) 21-35*

Submission date: *5 February 2022 Accepted: 16 December 2022 Published: 1 January 2023*

Introduction

Urinary Tract Infections (UTIs) are the most common bacterial infections, as they contribute toone-third of all nosocomial infections.[1]Implications of UTIs are severe as they impose great morbidity, mortality, and serious economic consequences on public health.[2] The magnitude of UTI severity ranges from self-limiting infection to death-causing systemic disease. Globally, millions of people have UTI each year, and the same number of people are at risk of acquiring this infection.[1] Diabetes mellitus, advanced age, urinary tract obstruction, immune suppression, and neurological disorders are the risk factors that make people susceptible to UTIs. Diverse microorganisms are adduced with UTIs, the most prevalent are Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, Staphylococcus aureus, and Staphylococcus saprophyticus.[3] There are many published reports in the last decades which drew a conclusion of increased drug-resistant bacteria in UTIs worldwide. In earlier studies, it is also concluded that the microorganism responsible for UTIs and its drug sensitivity pattern can be changed based on the geographic and biological status of the subjects.[4] Antimicrobial re-

sistance is always a major concern for many life-threatening infections. In the case of UTIs self-medication and poor diagnostic and culture facilities are the major factors considered for antimicrobial resistance in many developing countries.[5] Therefore, in a developing country like Eritrea, antibiotic treatment for Urinary Tract Infections must rely on the institutional susceptibility profile of the bacteria. Numerous published studies state that those people who are unable to empty the bladder due to neurological conditions like stroke, multiple sclerosis, and spinal cord injuries often require catheters.[6]There are reports which manifest a strong relationship between catheter usage and UTIs.[7,8]Urinary Tract infected patients are generally catheterized for their safety and prevention of further complications, but extended catheter usage increases the risk of morbidity among hospital and nursing home admitted UTI patients.[9]

Catheter-related infections are widespread if the use of catheters is not properly directed.An earlier study reported that around 12% to 16% of total hospitalized patients are catheterized, and the majority of them don't have proper direction and knowledge about catheter usage and its impact on the health of hospitalized patients. A report from The American National Healthcare Safety Network (NHSN) mentioned that almost 75% of UTI-infected patients in the hospital are related to extended usage of a catheter, and it is considered a high-risk factor for developing Catheter-Associated Urinary Tract Infection (CAUTI).[10,11]

Long-term health consequences are widespread in any armed conflict, even in fighters who return to civilian life.[12]Many government and Non-government organizations (NGOs) participate actively in the treatment and compensation of war-disabled people, as it is a major and long commitment.[13] Any armed conflict causes a serious impact on the physical and mental health of combatants, the same issues were noticed by many Eritreans after the Ethio- Eritrean war. After independence, the Eritrean government released many war-disabled veterans from active duty, which helped them lead civilian life and become productive members of the society.[14]The present study was conducted in Denden Military Hospital of Asmara, Eritrea. The main responsibility of Denden hospital is to provide medical services to patriots and to the late youngsters who participated actively and physically disabled during the war for securing independence from Ethiopia.[15] Therefore, assessing the prevalence of UTIs and determining the common etiologic agents along with their susceptibility profiles among war-disabled patients of Denden Hospital is important in planning for any intervention to control the infection among the patients. Furthermore, the information obtained from the current study may be used in a wider sense to understand the drug resistance of encountered isolates in association with catheter usage and provide reference data for further studies. As the study was targeted at disabled patients, the findings can be used as a reference to compare the prevalence and etiologic agents with those of physically normal patients. The identification of resistant organisms to antibiotics will provide a base to revise the existing treatment guideline.

Materials and methods:

Study Design

This was a prospective cross-sectional study conducted to investigate the prevalence, identification of common etiological agents, and the drug resistance pattern of etiological agents identified among war-disabled patients suffering from UTI at Denden Military Hospital, Asmara, Eritrea.The study was conducted from April - December 2021.

Sample Size

The sample size determination was done using a formula for a small population with an assumption of 50% prevalence, since no previous study was done in the area. 95% CI, 5% margin of error and 5% of non-respondent rate gave a final sample size of 236.[16]

Sampling Technique

In this study, 236 war-disabled patients who were taking treatment in Denden Military Hospital for different disabilities were selected using a simple random sampling method. Urinalysis, culture, and antimicrobial sensitivity patterns were performed. The results obtained were analized with a statistical package and printed as a hard copy. The results will be used as a reference for decreasing the prevalence of UTI in the hospital and modifying any necessary practices that would decrease the rate of infection.

Reagent Preparation

The analytical part of the study started with preparing the required materials, reagents, and equipment before the collection of samples, and transporting them to the site of analysis. The culture media were allowed to come to room temperature to prevent thermal shock, the media were, therefore, left in open air in the laboratory before inoculating the samples. Each sample was labeled with a series of numbers that contains the date of collection and the sample code.

Sampling Criteria

The study subjects to be sampled were primarily selected based on whether they have taken any antibiotics within the previous two weeks; those individuals who had been treated within two weeks with antibiotics were not allowed to participate in the study. Catheterized patients were asked to change their catheters before sampling because contaminating organisms may arise due to the long-time stay of the catheter.

Sample Collection

A sterile cup labeled with number codes and a questionnaire was provided for each eligible subject. The non-catheterized and condom catheterized subjects were asked to clean their genital area with clean water before they collect their midstream clean-catch urine. The catheter was changed for all

catheterized subjects before the collection of urine. The samples were transported to the site of analysis within one hour of collection in tightly capped cups using a sample transport box.

Urine Analysis, Cytology, and Sediment gram

A chemical indicator-impregnated test strip was dipped into a standard urine test tube containing 12-15ml of urine. The chemical strip develops a color change as the indicator is exposed to the chemical constituents of the urine. The urine in the test tube was then subjected to centrifugation at 2500rpm for five minutes.Decant, the supernatant,and sediment were suspended, and a drop was put on a slide with a coverslip and examined for pus cells, Red Blood Cells (RBC), bacteria, and casts. An examination is done initially at a low-power (10X) and then at a high -power (40X) field. Based on the presence of cells by microscopy, the samples were categorized as "Full, much, moderate, and none".

Inoculation of a Urine Sample

Cysteine-lactose-electrolyte-deficient agar, Mac-Conkey agar, Mannitol salt agar, Eosin methylene blue, and 5% Blood agar plates (Oxoid, Ltd, UK) were used for culturing each collected urine sample. Approximately 0.002 ml of urine was used with the help of a calibrated wire loop and streaked on a freshly prepared differential and selective culture media. The streaked plates were incubated at 37°C, overnight,the incubation was extended up to 48 hours for slow-growing strains. After the completion of incubation, the plates were inspected for growth and colony characteristics. If a single bacterium was recovered at a concentration $\geq 10^5$ colony-forming units per milliliter of urine, the culture was considered significant for UTI. Different biochemical tests like Gram's reaction, Indole test, Methyl red, Voges–Proskauer, Citrate utilization, Tryptophan deaminase reaction (TDA) Oxidase, Catalase, Triple Sugar Iron test (TSI), Fermentation of carbohydrates (such as glucose, sucrose, mannitol,) and utilization of Amino acids (such as Lysine, Ornithine, Arginine), was done with the bacterial colonies differing in size, shape, and color for further characterization and identification of bacteria at the species level.[17-26]All Biochemical reagents were obtained from (Oxoid, Ltd, UK).

Antimicrobial Susceptibility Test

The antibiotic sensitivity profile of each isolate was done by the Kirby-Bauer disc diffusion method using Mueller Hinton Agar **(**Himedia®,Mumbai, Maharashtra, India**).**[27] Eleven commercially available antibiotic discs for Gram-negative and seven for Gram-positive (Himedia®, Mumbai, Maharashtra, India) were used for the identification of antibiotic susceptibility. The isolates were recorded as "sensitive, intermediate, or resistant" based on the Clinical Laboratory Standards Institute (CLSI 2019) criteria.[28]

Quality Control of Materials and Reagents

To maintain the quality of the specimen and to come up with the required viability of the microorganisms, urine which had not stayed greater than an hour was inoculated. Along with this, to signify the quality of media, the powder form of different types of agar was checked for the expiration date. After preparation, all culture media were incubated in an incubator at the beginning (100%) and following (10%) to control growth and predict the degree of contamination. The quality control of all solid and liquid media for different tests was done by inoculating known standard organisms like (American Type Culture Collection) ATCC 29213 for *S.aureus* and ATCC 25922 for *E.coli*.

Ethical Consideration

Since Denden Military Hospital is a resident of war-disabled patients, it encompasses high ethical issues. The research got ethical clearance from the ethical committee of Asmara College of Health Sciences and the Ministry of Health, Asmara, Eritrea (ACHS/ SAHP/ 03/2019). Personal consent was taken from each participant after explaining the purpose and procedure of the study. The patients' results in this study were kept confidential. The overall study results were given to the administrators of the hospital to use as a base for further intervention in the control and prevention of UTIs, which can help the patients get better treatment and care.

Data Analysis

Data were analyzed using SPSS version 20.1. The UTI status was recorded as present or not present as our primary outcome, and if the number of bacteria is $>10^5$/mL in the urine, it implies the presence of UTI. The total prevalence of UTI was calculated by dividing the number of participants by the total number of study subjects who took the culture test with the presence of $>10^5$/mL of bacteria in their urine. To descriptively summarize the categorical characteristics of the study participants,frequencies and percentages were used. For testing the difference in proportions of UTI across categorical variables, Pearson Chi -square/Fisher Exact Test was used. The P-value of ≤ 0.05 was considered significant in analyzing the relationship between variables. The odds ratio and 95% Confidence Interval (CI) were also calculated to identify statistical significance.

Results

Description and clinical information of the study subjects

The participants of this study were 236 war veterans who were disabled during the war and taking treatment at Denden Military Hospital. Those patients who gave consent and complied with the designed criteria of selection were selected for the study. Out of the 236 participants involved in the study, 226 (95.7%) were males. The mean age of the subjects

was 46.7 years with a standard deviation of 7.9 and ranged from 27 to 70 years. No demographic and socioeconomic status of the study participants were collected for the study. From a total of 236 participants who had not taken any antibiotics within the last two weeks, 208(88.1%) had at least one complaint of UTI. While the remaining 28(11.8%) did not have any complaint of UTI during their disabled period of life. Out of the 208 participants who had at least one complaint of UTI, 150 (72.1%) were experiencing a recurrent infection and the rest 58(27.8%) just had a history of UTI infection without recurrence. The subjects of the study had different statuses of catheterization ranging from non-catheterized 110 (46.6%) to Condom catheterized 61 (25.8%), Urethral catheterized 42 (17.7%), and Supra-pubic 23 (9.7%).

Urine Culture Results of War-Disabled Patients in Denden Hospital

Urine culture was carried out on all 236 participants, where urine samples were inoculated into different culture media. The outcome of the culture result indicated 193(81.7%) with positive growth, and the remaining 43(18.2%) showed no growth on any of the media inoculated. Among the 193 participants who showed significant growth, 65(33.6%) were with more than one isolate, while the remaining 128 (66.3%) showed a single isolate. In total, 198 isolates with 21 different species were recovered from 19 growth-positive participants. Based on the findings, *E. coli,* a Gram-negative bacterium, with the greatest percentage and frequency 73(36.8%), followed by *Staphylococcus aureus* 38(19.1%) the only Gram-positive bacteria found in this study.*P. aeruginosa* and *P. mirabilis,*the other Gram-negative bacteria together were 30 (15.1%), while the rest were made 57 (28.7%). Different types of biochemical tests and Gram staining were done to differentiate bacteria at the species level. (**Figure 1)**

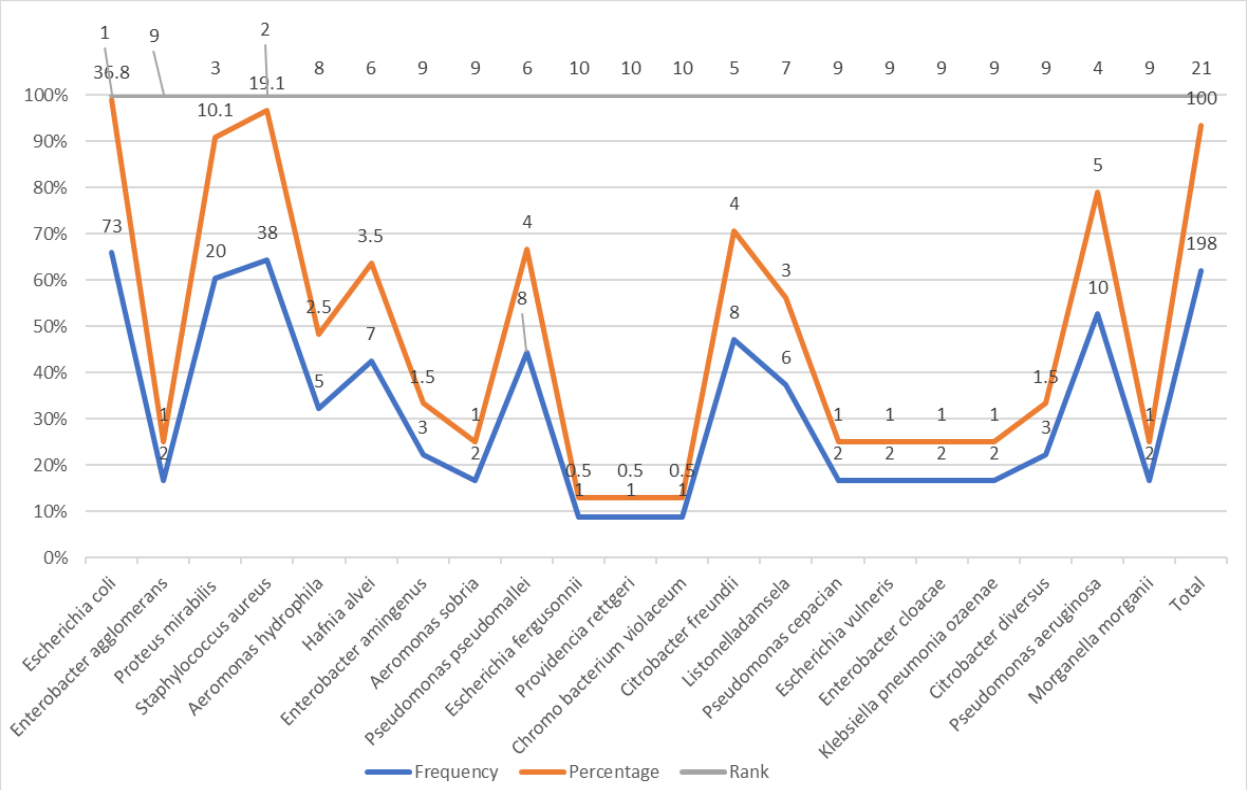

Figure-1: Type and Frequency of Organisms Isolated from Urine Specimen of Disabled Patients in Denden Military Hospital, Asmara, Eritrea

Relationship of Urine Chemical and Sedimentation Tests with Culture results of Disabled Patients in Denden Hospital

Routine microscopic and chemical tests were performed on all 236 urine samples for different types of diagnostic parameters like Red Blood Cells, pus cells, bacteria, chemical tests for leukocytes, and blood nitrate test. The detailed results are shown in **Table 1** Logistic regression of variables was also done to identify a significant or nonsignificant relationship between diagnostic parameters and the growth of bacteria in urine samples of War Disabled Patients **(Table 2).**

Table 1: Urine Chemical and Sedimentation test results of Disabled Patients in Denden Hospital, Asmara, Eritrea

Diagnostic Parameters	Grade Total (236)	Growth of Bacteria (193)	Chi (c2), P-value
Chemical Leukocyte Test	Neg (n=62)	47(75.8%)	c2=5.08
	+1 (n=25)	18 (72%)	P Value <0.044
	+2 (n=36)	32 (88.8%)	
	+3 (n=113)	96(84.9%)	
Chemical Blood Test	Neg (n=86)	57 (66.2%)	c2=34.22
	+1 (n=30)	21 (70%)	P Value <0.001
	+2 (n=40)	40 (100%)	
	+3 (n=25)	25 (100%)	
	+4 (n=55)	50 (90.9%)	
Chemical Nitrite Test	Positive (n=98)	92(93.8%)	c2=16.46
	Negative (n= 138)	101(73.1%)	P Value <0.001
Pus cell Microscopy	Full of (n=125)	118 (94.4%)	c2=60.19
	Many (n=16)	14 (87.5%)	P Value <0.001
	Moderate (n=12)	12 (100%)	
	Few (n=36)	28 (77.7%)	
	None (n=47)	21 (44.6%)	
RBC Microscopy	Full of (n=28)	28 (100%)	c2=23.90
	Many (n=32)	31 (96.8%)	P Value <0.001
	Moderate (n=9)	9 (100%)	
	Few (n=62)	52 (83.8%)	
	None (n=105)	73 (69.5%)	
Bacteria Microscopy	Full field (n=14)	12 (85.7%)	c2=26.61
	Moderate (n=30)	30 (100%)	P Value <0.001
	Few (n=46)	46 (100%)	
	None (n=146)	105 (71.9%)	

Table 2: Logistic regression of variables about different Diagnostic Parameters

Diagnostic parameters	Grade Total (236)	Growth of Bacteria (193)	Odds Ratio	95% CI	P-value
Chemical Leukocyte Test	Neg (n=62)	47(75.8%)	-	-	-
Chemical Leukocyte Test	+1 (n=25)	18 (72%)	1.219	0.427-3.478	0.712
	+2 (n=36)	32 (88.8%)	0.392	0.119-1.289	0.123
	+3 (n=113)	96(84.9%)	0.555	0.255-1.207	0.137
	+3 (n=25)	25 (100%)	-	-	-
	+4 (n=55)	50 (90.9%)	0.197	0.071-0.546	0.002
Chemical Nitrite Test	Positive(n=98)	92(93.8%)	0.178	0.072-0.441	<0.001
	Negative (n= 138)	101(73.1%)	-	-	-
Pus cell Microscopy	Full of (n=125)	118 (94.4%)	0.048	0.018-0.125	<0.001
	Many (n=16)	14 (87.5%)	0.115	0.024-0.565	0.008
	Moderate (n=12)	12 (100%)	-	-	-
	Few (n=36)	28 (77.7%)	0.231	0.087-0.611	0.003
	None (n=47)	21 (44.6%)	-	-	-
RBC Microscopy	Full of (n=28)	28 (100%)	-	-	-
	Many (n=32)	31 (96.8%)	0.074	0.010-0.563	0.012
	Moderate (n=9)	9 (100%)	-	-	-
	Few (n=62)	52 (83.8%)	0.439	0.198-0.971	0.042
	None (n=105)	73 (69.5%)			
Bacteria Microscopy	Full field (n=14)	12 (85.7%)	0.427	0.092-1.991	0.279
	Moderate (n=30)	30 (100%)	-	-	-
	Few (n=46)	46 (100%)	-	-	-
	None(n=146)	105 (71.9%)	-	-	-

Relationship of Catheter usage with Culture Results and Development of Infection

In our study, out of a total of 236 participants, 126 (53.3%) were catheterized with different types of catheters and the rest 110(46.6%) were non-catheterized. Urinary tract infection was high in catheterized participants compared to non-catheterized 118 (93.6%) (Chi c2=25.57, P value<0.001). In our study, we found 208 participants out of 236 had at least one complaint of UTI during the disability period. The analysis of results concerning catheters are shown in **Tables 3 and 4.**

Table 3-: Association of Catheter Usage and Culture Growth Pattern

Type of catheter		Growth (n=193),	No Growth (n=43),	Chi (c2), P-value
Catheter	Supra pubic (n=23)	22 (95.6%)	1(4.3%)	c2=1.08 P>0.50
	Urethral (n=42)	38 (90.4%)	4 (9.5%)	
	Condom (n=61)	58 (95%)	3 (4.9%)	
Sub total	(n=126)	118(93.6%)	8 (6.3%)	c2=25.57 P value<0.001
No catheter	(n=110)	75 (68.1%)	35 (31.8%)	

Table 4: Logistic regression of variables to establish an association of Catheter Usage and Bacterial Culture Growth Pattern in War Disabled Patients

Type of catheter		Growth	No Growth	Odds Ra-	95% CI	P-value
Catheter	Supra pubic	22 (95.6%)	1(4.3%)	0.879	0.0871-8.905	0.913
	Urethral (n=42)	38 (90.4%)	4 (9.5%)	2.035	0.431-9.606	0.369
	Condom (n=61)	58 (95%)	3 (4.9%)	-	-	-
Sub total	(n=126)	118(93.6%)	8 (6.3%)	0.145	0.064-0.330	
No catheter	(n=110)	75 (68.1%)	35 (31.8%)	-	-	-

Antimicrobial Susceptibility Pattern of Isolates

A total of 173 common isolates obtained after urine culture were tested against several drugs to assess their antibiotic susceptibility patterns. Eleven different antibiotics were used for 135-Gram-negative bacteria, and 7 antibiotics were tested against 38 *Staphylococcus aureus* isolates. The selection of antibiotics was based on the treatment guidelines of the country for treating different bacterial infections.[29,30].Gram-negative bacteria were found sensitive to Amikacin (76%), Gentamycin (72.5%), and Cefalexin (69%), and resistant to Nitrofurantoin (78%), Ampicillin (69.3%), Co-trimoxazole (71.2%), and Nalidixic acid (68%). Of Gram-negative isolates, *E.coli* showed higher sensitivity to Amikacin (79.4%) and Gentamycin (75.3%), while it was resistant to Nitrofurantoin (84.9%) and Ampicillin (75.3%). *Pseudomonas spp*. showed higher sensitivity to Cefalexin (77.7%) and Gentamycin (77.7%), but showed resistance to Nitrofurantoin (55.5%) and Nalidixic acid (61%). *Proteus* spp. showed higher sensitivity to Amikacin (85%), and Gentamycin (85%), but were resistant to Ampicillin (100%), Nitrofurantoin (100%), and Co-trimoxazole (100%).**Table 5** Only one type of Gram -positive bacteria was isolated and it showed a higher level of sensitivity to Amikacin (92.1%) followed by Ciprofloxacin (71%) but was found resistant to Tetracycline (65.7%).**Table 6**

Table 5: Antibiotic Sensitivity Pattern of Selected Gram-negative organisms to standard antibiotics among UTI patients of Denden hospital, Asmara, Eritrea

			Amikac	**Ampicill**	**Ceftazi**	**Cefalex**	**Ciproflo**	**Genta**	**Chlorom**	**Nalidix**	**Cotrimo**	**Nitrofur**	**Tetracy**
E.coli	73	Sensitive	58	12	49	49	34	55	32	15	18	9	20
			79.40%	16.40%	67.10%	67.10%	46.50%	75.30%	43.8%	20.50%	24.60%	12.30%	27.30%
		Intermediate	0	6	1	9	2	3	9	3	4	2	3
			0%	8.20%	1.30%	12.30%	2.70%	4.10%	12.30%	4.10%	5.40%	2.70%	4.10%
		Resistant	15	55	23	15	37	15	32	55	51	62	50
			20.50%	75.30%	31.50%	20.50%	50.60%	20.50%	43.80%	75.30%	69.80%	84.90%	68.40%
Pseudomonas spp	18	Sensitive	11	7	7	14	10	14	10	7	8	8	11
			61.10%	38.80%	38.80%	77.70%	55.50%	77.70%	55.50%	38.80%	44.40%	44.40%	61.10%
		Intermediate	0	4	3	1	3	1	3	0	0	0	0
			0%	22.20%	16.60%	5.50%	16.60%	5.50%	16.60%	0%	0%	0%	0%
		Resistant	7	7	8	3	5	3	5	11	10	10	7
			38.80%	38.80%	44.40%	16.60%	27.70%	16.60%	27.70%	61.11%	55.50%	55.50%	38.80%
Proteus mirabilis	20	Sensitive	17	0	17	9	20	17	0	3	0	0	3
			85%	0%	85%	45%	100%	85%	0%	15%	0%	0%	15%
		Intermediate	3	0	0	11	0	0	0	0	0	0	0
			15%	0%	0%	55%	0%	0%	0%	0%	0%	0%	0%
		Resistant	0	20	3	0	0	3	20	17	20	20	17
			0%	100%	15%	0%	0%	15%	100%	85%	100%	100%	85%
Citrobacter spp	8	Sensitive	6	2	7	6	5	5	3	2	2	2	1
			75%	25%	87.50%	75%	62.50%	62.50%	37.50%	25%	25%	25%	12.50%
		Intermediate	0	0	0	2	0	0	1	1	0	0	0

			Ami-kac	Am-picill	Ceftazi	Ce-falex	Ciproflo	Gen-ta	Chlorom	Na-lidix	Co-trimo	Ni-trofur	Tetra-cy
			0%	0%	0%	25%	0%	0%	12.50 %	12.50 %	0%	0%	0%
		Re-sistant	2	6	1	0	3	3	4	5	6	6	7
			25%	75%	12.50 %	0%	37.50 %	37.50 %	50%	62.50 %	75%	75%	87.50 %
Aeromonas spp	7	Sen-sitive	7	1	4	5	3	4	3	2	2	0	2
			100 %	14.20 %	57.10 %	71.40 %	42.80 %	57.10 %	42.80 %	28.50 %	28.50 %	0%	28.50 %
		Inter-mediate	0	1	0	0	0	0	0	1	0	1	1
			0%	14.20 %	0%	0%	0%	0%	0%	14.20 %	0%	14.20 %	14.20 %
		Re-sistant	0	5	3	2	4	3	4	4	5	6	4
			0%	71.40 %	42.80 %	28.50 %	57.10 %	42.80 %	57.10 %	57.10 %	71.40 %	85.70 %	57.10 %
			0%	71.40 %	42.80 %	28.50 %	57.10 %	42.80 %	57.10 %	57.10 %	71.40 %	85.70 %	57.10 %
Enterobacter spp	9	Sen-sitive	5	4	5	7	7	7	5	3	3	3	3
			55.50 %	44.40 %	55.50 %	77.70 %	77.70 %	77.70 %	55.50 %	33.30 %	33.30 %	33.30 %	33.30 %
		Inter-mediate	0	0	1	1	0	1	0	0	1	0	1
			0%	0%	11.10 %	11.10 %	0%	11.10 %	0%	0%	11.10 %	0%	11.10 %
		Re-sistant	4	5	3	1	2	1	4	6	5	6	5
			44.40 %	55.50 %	33.30 %	11.10 %	22.20 %	11.10 %	44.40 %	66.60 %	55.50 %	66.60 %	55.50 %

Amikac-Amikacin Ampicill- Ampicillin Ceftazi-Ceftazidime Cefalex- Cefalexin Ciproflo-Ciprofoxacin Genta-Gentamycin Chlorom-Chloramphenicol Nalidixic acid Cotrimo- Cotrimoxazole Nitrofur-Nitrofurantoin Tetracy-Tetracycline

Table 6: Antibiotic Sensitivity Pattern of selected Gram-positive organisms to standard antibiotics among UTI patients of Denden hospital, Asmara, Eritrea

	Erythro	Ampi	Vanco	Cipro	Genta	Chloram	Tetracy
Sensitive	19	35	24	27	20	25	10
	50%	92.10%	63.10%	71%	52.60%	65.70%	26.30%
Intermediate	8	-	3	3	5	5	3
	21%	-	7.80%	7.80%	13.10%	13.10%	7.80%
Resistant	11	3	11	8	13	8	25
	28.90%	7.80%	28.90%	21%	34.20%	21%	65.70%

Erythro-Erythromycin Ampi-Ampicillin Vanco-Vancomycin Tetra-Tetracycline
Cipro-Ciprofloxacin Genta-Gentamycin Chlorom-Chloramphenicol

Discussion

To our knowledge, the current study is the first to determine the Prevalence, common Etiologic agents, and Antimicrobial Susceptibility Patterns of UTI among war Disabled Patients in Asmara, Eritrea.

The government of Eritrea within its limited resources always took a maximum attempt to help and assist people who were with war disabilities, to gain maximum potential, and to minimize the suffering that the war veterans experienced during the conflict. Along with Eritrean government efforts, the people of Eritrea also have great respect for the war-disabled veterans, and there is always an honor for the great service and sacrifices which they rendered for their liberty and security. The Eritrean government along with the people also recognizes the rights of war-disabled veterans, the right to be treated with respect and dignity.[14]

A planned and well-organized assessment should be a priority regarding identifying health issues and solving those issues in special groups like war-disabled veterans.[31]

Agha *et al*. in their study mentioned a disparity between the resource allocation and health status of the general population and war veterans.[32] Armed conflicts lead to battlefield injuries, and these injuries can be long-term physical or mental, and can severely affect their response to treatment.[33,34]Therefore, healthcare planning and resource allocation to veterans should be different and more special than the non-veteran patient population.[32]

Battlefield injuries can cause different types of disabilities. The most common and accepted disabilities among war veterans are eye and ear disorders, musculoskeletal disorders, and mental health disabilities.[35] The mortality rate among war veterans with lower extremity amputations is higher than the normal population in a 24-year follow-up study.[36]While another study conducted among war veterans reported that kidney and urinary tract diseases are one of the most prevalent illnesses.[37]

Here in our study, we have taken war veterans from Denden Military Hospital which is treating patients with all forms of disability. The prevalence of UTI among our patients is (81.7%), which is comparatively similar to combatants of world war I, as approximately (80%) of them died due to pyelonephritis.[38,39]At the same time, any war disability requires short or long term hospitalization, and 40% of nosocomial infections are urinary tract infections.[40]In our study, all war disabled patients were taking treatment in Denden Military Hospital.

Structural,physiological and behavioral disorders as well as demography are generally considered risk factors for UTI, among which, structural and physiological disorders are the most commonly accepted risk factors.[41]Amputations,urogenital, urethral, and spinal cord war injuries can lead to long-term disability, and these injuries can also be risk factors for

UTI.[42-44] In our study, we have not taken any account on the type of war injuries, instead,we focused only on war disabled veterans.

Catheter usage has a great impact on the risk of UTI. [41]Out of 236 war-disabled patients, 126 (53.3%) were using different types of catheters for bladder drainage.Those subjects who were using catheters showed a high prevalence of UTI compared to those who were not using any catheter**.** Previous studies showed that patients with genitourinary, urethral, and spinal cord war injuries often require catheteres for bladder drainage, and some cases of war amputation also need a catheter for UTI management.[41,42,44,45] Bacteremia is another health issue associated with catheters among UTI patients,the case fatality rate is three times higher in comparison to non-bacteriuric patients.[46-49]

In the present study, catheterized participants were using different types of catheters, which include suprapubic, urethral, and condom, and all of them showed a high presence of bacteria in their urine culture. Earlier studies done on Spinal cord injury patients reported that bacteriuria is less common with intermittent catheterization (70%) compared to indwelling catheters (98%).[41]

The results of our study on catheterized participants are validated by the previous reports, which showed that the usage of either suprapubic or urethral catheters can lead to serious UTIs compared to non-catheterized participants. Earlier studies suggested that the usage of condom catheters lowers the incidence of bacteriuria, and they are more comfortable [50]. At last, the usage of chronic indwelling catheters must be based on prolonged comfort for the patient and the mindset of a physician,which allows them to manage challenges related to catheters.[51]

In our study, there were 110 non-catheterized participants, and the prevalence of UTI among them was (68%). As mentioned earlier, the behavior of disabled people can also be a risk factor for UTI.Therefore, failing to adjust to disability and having poor personal hygiene can be contributing factors to the high prevalence of UTI in non-catheterized war-disabled patients.[41]

Battlefield injuries can lead to serious complications of infections which can result in amputation, loss of function, or death. Thus, the characterization of the bacteria could influence the selection of empiric antimicrobial agents used to prevent infection. In our study, the prevalence of Gram-negative bacteria especially *E.coli* was high compared to other Gram-negative bacteria. *Staphylococcus aureus*is the only Gram-positive bacteria reported in the present study.

In earlier studies done on combat-related genitourinary trauma, extremity injuries, burn injuries,and spinal cord injuries concerning UTIs, the most frequent bacteria reported were E.coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Coagulase-negative staphylococcus, and Staphylococcus aureus.[52-56]

In our study (100%), patients are living in Denden War disabled veterans'/military hospital. There are previous reports that state that Urinary Tract infections are widespread in long–term–care facility residents, and the most frequent pathogens isolated were *E. coli,*Coagulase -negative *Staphylococcus,*and *Streptococcus.*[57]

In the present study, the presence of pus cells, and white blood cells are proof that these cells failed in fighting the infection of the body, which causes a significant growth of bacteria in the body. Pyuria, which is the presence of pus cells in the urine, is a warning of microbial infection in the body.[58]While in those patients where there is only microbial growth (bacteriuria) without pyuria, it is a sign of diabetes, enteric fever, bacterial endocarditis, or contaminants from the perineum,[59] as well as it might be a urinary tract infection caused by apathogenic microorganism such as *E. coli*, *Klebsiella*, and Proteus.[59] In the same way, a positive nitrite test was associated with significant bacterial growth in the urine samples of War Disabled Veterans. Pathogens such as *E.coli, Proteus species*, and *Klebsiella species* when present in sufficient concentration in the urine, can reduce nitrate to nitrites, and this sufficient presence of nitrite in urine indicates UTI. [59] Similarly, a high count of RBCs in the urine with nitrite and pus cells also indicates an infection.[59]

Military conflicts increase the risk of acquiring new multidrug-resistant strains of bacteria and their distribution and spreading.[54] There is a great possibility of the inflow of multidrug-resistant bacteria by soldiers on deployment. As the soldiers are repatriated due to appalling diseases or injuries during deployment, they can easily transfer those multidrug-resistant bacteria into the hospitals where they are getting treated in the home country.[54]In our study Gram-negative bacilli, especially *E. coli,* exhibited a wide spectrum of resistance to Ampicillin, Nalidixic acid, and Nitrofurantoin, reducing their empirical usages. Apart from *E. coli*, other Gram-negative bacilli such as *K. pneumonia*, *Proteus spp*, *Citrobacter spp,Aeromonas spp*, and *Enterobacter spp* also exhibited resistance to similar antibiotics in varying degrees. As there is a high level of resistance exhibited by Gram-negative bacteria against routinely used antibacterial drugs such as ampicillin, nitrofurantoin, nalidixic acid and Co-trimoxazole,which is a major upset for the effective care of UTI in war-disabled people. A study conducted in Denden Hospital, Asmara, Eritrea also showed a lower level of sensitivity to Ampicillin, Nalidixic acid, and Co-trimoxazole against a variety of Gram-negative bacteria.[15]While in the current study, only Gram-positive bacteria showed an elevated level of resistance to tetracycline.

Conclusion and recommendation:

The results of our study showed that urinary infection is an important clinical problem among the military trauma population. Our results also displayed that UTI is also a widespread problem among long-term–hospital residents. The current study demonstrated that *S.aureus* and *E.coli* are

common pathogens isolated from war-disabled patients and taking treatment in Denden Military Hospital, Asmara, Eritrea. This study also found that the presence of bacteria in urine is high in catheterized patients, in comparison to non-catheterized disabled patients. Catheterized patients were using different types of catheters, and all types of catheter usage demonstrated a high presence of bacteriuria. The current study also tried to identify the AST pattern of isolated bacteria to drugs that are in clinical practice in the country for the treatment of UTI. Here, we found that most isolated bacteria were resistant to antibiotics. Healthcare professionals and policymakers of the hospital must consider this resistance pattern in their clinical practice as well as in the policy-making process. Based on the results of antimicrobial susceptibility tests, it is recommended to continue with drugs like Amikacin, Gentamycin, Ciprofloxacin, and Ampicillin for the management of both Gram-negative and positive uropathogens respectively. Most importantly, the current AST data can be used to understand the trends of antibiotic susceptibility, this can assist clinicians in prescribing the correct antimicrobial therapy to prevent indiscriminate use of antibacterial drugs and resistance emergence.

Conflict of Interest: No Conflict of Interest

Acknowledgments:
Our research team would like to thank academic and clinical staff members of the National Health Laboratory, Denden Hospital, and Asmara College of Health Sciences.
Registration number:ACHS/ SAHP/ 03/2019

References:

1. Lee SW, Kim YH (2015). Uropathogens based on Antibiotic Susceptibility. Urogenital Tract Infection 10: 67 -73.
2. Smith AC, Almond M (2007). Management of urinary tract infections in the elderly. Trends UrolGynaecol Sex Health 12: 31-34.
3. Kibret M, Abera B (2014). Prevalence and antibiogram of bacterial isolates from urinary tract infections at Dessie Health Research Laboratory, Ethiopia. Asian Pac J Trop Biomed 4: 164-168.
4. Rowe TA, Juthani-Mehta M (2013). Urinary tract infection in older adults. Aging Health. 9(5) P.1-12
5. Baral P, Neupane S, Marasini BP, Ghimire KR, Lekhak B, et al. (2012) High prevalence of multidrug resistance in bacterial uropathogens from Kathmandu, Nepal. BMC Res Notes 5: 38.
6. Hakansson MÅ (2014). 'Reuse versus single-use catheters for intermittent catheterization: what is safe and preferred? Review of current status', Spinal Cord,52(7), pp. 511–16.
7. Woodward S, (2014). '*Community nursing and intermittent self-catheterisation'*, British Journal of Community Nursing, vol. 19, no 8, pp. 388–93.
8. Damanski N, Gibbon N (1956). The upper urinary tracts in the paraplegic. Br JUrol.; 28:24–36.
9. Ioannis E. and Kostadinos S. (2013). Prevention of Catheter-Associated Urinary Tract Infections. University Hospital OfAlexanrdoupolis, General Hospital of Kalamata; Greece.
10. Gail L, J. (2016). Prevention of Catheter Associated Urinary Tract Infections in a Long-term Acute Care Hospital by. Available at: http://hdl.handle.net/10755/201826.
11. The American National Healthcare Safety Network (NHSN) 2014.
12. Levy BS, Sidel VW. Health effects of combat: a life-course perspective. Annu Rev Public Health. 2009; 30:123–136.
13. Crum-Cianflone NF(2013). The Millennium Cohort Study: answering long-term health concerns of US Military Service members by integrating longitudinal survey data with military health system records, chapter 5. In: Hendricks AJ, ed. Military Health Care: From Pre-Deployment to Post-Separation. New York, NY; 55–77.
14. https://shabait.com/2019/12/04/respecting-persons-with-disabilities/

15. Lia Alem, Salih Mohammed, Mohammed Elfatih Humida, Berzelin Adugna, Feven G. Medhin, Temesgen Weldu (2019). Antibiotic Sensitivity Patterns of Urine and Biofilms in Patients with Indwelling Urinary Catheter in Denden Hospital, Asmara, Eritrea.Advances in Microbiology, 9, 131-138.
16. Mohamad Amin Pourhoseingholi, Mohsen Vahedi, Mitra Rahimzadeh (2013). Sample size calculation in medical studies. Gastroenterol Hepatol Bed Bench 6(1):14-17
17. Arunava Das, Ashish Rathore, C Janani, C Hemanth, R Arvind Balakrishnan (2013). Diagnosis Of Motile Aeromonas Sobria From Cat Fishes With Septicemia By PCR. IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS). 2(6), PP 87-91.
18. Yahyan A. Abbas, Ghosoon Fadhel Radhi (2016). Rapid Identification of Enterobacter Spp. Isolated From Hospitals In Basrah Province By Automated System (Vitek®2 Compact). International Journal of Micro Biology, Genetics and Monocular Biology Research Vol.2, No.2, pp.9-20.
19. Don J. Brenner, Alma C. Mcwhorter. Jean K. Leete Knutson (1982). Arnold G. Steigerwalt. Escherichia vulneris: a New Species of Enterobacteriaceae Associated with Human Wounds. Journal Of Clinical Microbiology. Vol. 15. No. 6. p. 1133-1140.
20. Ingo Stocka, Motiur Rahmanb, Kimberley Jane Sherwooda, Bernd Wiedemanna (2005). Natural antimicrobial susceptibility patterns and biochemical identification of Escherichia albertii and Hafnia alvei strains. Diagnostic Microbiology and Infectious Disease 51, 151 – 163
21. G. Altmann, I. Sechter, D. Cahan, Ch. B. Gerichter (1976). Citrobacter diversus Isolated from Clinical Material. Journal Of Clinical Microbiology, 3(4) p. 390-392.
22. J. Michael Janda, Sharon L. Abbott, Wendy K. W. Cheung, Deborah F. Hanson (1994). Biochemical Identification of Citrobacteria in the Clinical Laboratory. Journal Of Clinical Microbiology, Vol. 32, p. 1850-1854.
23. Barbara Glover, Jeanette Wentzel, Akinbowale Jenkins, Moritz van Vuuren (2017). The first report of Escherichia fergusonii isolated from nonhuman primates in Africa. One Health.
24. Elvira Beli, Esat Duraku (2017). Escherichia fergusonii strains isolated from clinical specimens in Albania. Journal of Multidisciplinary Engineering Science and Technology (JMEST). Vol. 4 Issue 4, 7085-88.
25. Dennis S. Hansen, Hazel M. Aucken, Titi Abiola, Rainer Podschun (2004). Recommended Test Panel for Differentiation of Klebsiella Species on the Basis of a Trilateral Interlaboratory Evaluation of 18 Biochemical Tests. Journal Of Clinical Microbiology. Vol. 42, No. 8, p. 3665–3669.
26. Jamela Gh. Auda, Ibtesam Gh. Al-Grawi (2009). Isolation, Identification, and Antimicrobial Susceptibility of Uropathogenic Morganella Morganii. Al- Kindy Col Med J; 5 (1) P:32-35
27. Bauer AW, Kirby WM, Sherris JC, Turck M (1966). Antibiotic suscep-tibility testing by a standardized single disk method. Am J Clin Pathol; 45:493-6.
28. Clinical and Laboratory Standards Institute (2019). Performance Standards for Antimicrobial Susceptibility Testing. 29th 251 ed. CLSI supplement M100. Clinical and Laboratory Standards Institute. Wayne, PA.
29. https://www.who.int/selection_medicines/country_lists/eri/en/
30. World Health Organization (2019). World Health Organization model list of essential medicines: 21st list.WHO press.
31. World Health Organization (2011). World Report on Disability: Geneva: WHO Press.
32. Agha Z, Lofgren RP, Van Ruiswyk JV, Layde PM (2000). Are patients at Veterans' affairs medical centers sicker? A comparative analysis of health status and medical resource use. Arch Intern Med.;160(21):3252–7.

33. Cross JD, Ficke JR, Hsu JR, Masini BD, Wenke JC (2011). Battlefield Orthopaedic injuries cause the majority of long-term disabilities. J Am Acad Orthop Surg. 19: S1–7.
34. Ramchand R, Rudavsky R, Grant S, Tanielian T, Jaycox L (2015). Prevalence of risk factors for, and consequences of posttraumatic stress disorder and other mental health problems in military populations deployed to Iraq and Afghanistan. Curr Psychiatry Rep.;17(5):37.
35. Philip M. Clarke, Robert Gregory, Joshua A. Salomon (2015). Long-term Disability Associated With War-related Experience Among Vietnam Veterans Retrospective Cohort Study. Medical Care Volume 53, Number 5.
36. Modan M, Peles E, Halkin H, Nitzan H, Azaria M, Gitel S, *et al* (1998). Increased cardiovascular disease mortality rates in traumatic lower limb amputees. Am J Cardiol.;82(10):1242–7.
37. Elahe Faraji, Mostafa Allami, Nafiseh Feizollahi, Amir Karimi, Amir Yavari, Mohammadreza Soroush, Majid Moudi (2018). Health concerns of veterans with high-level lower extremity amputations. Military Medical Research 5:36,
38. Kennedy RH (1946). The new view points towards spinal cord injuries. Ann Surg; 124:1057-65
39. Thomson-Walker JW (1919). Ureters and their orifices in gunshot wounds of the spine. BMJ; 1:325-6
40. Waites KB, Canupp KC, DeVivo MJ (1993). Epidemiology and risk factors for urinary tract infection following spinal cord injury. Arch Phys Med Rehabil; **74**: 691– 5.
41. Diana D. Cardenas, Thomas M. Hooton (1995). Urinary Tract Infection in Persons With Spinal Cord Injury. Arch Phys Med Rehabil Vol 76.
42. A.J. Ploeg, J.-W. Lardenoye, M.-P.F.M. Vrancken Peeters, P.J. Breslau (1956). Contemporary Series of Morbidity and Mortality after Lower Limb Amputation. Eur J Vasc Endovasc Surg 29, 633–637.
43. A R Mundy (2006). Management of urethral strictures. Postgrad Med J; 82:489–493.
44. David Band (1956). Section of Urology. Proceedings of the Royal Society of Medicine, 49(685)
45. Felicia L. Balzano, Steven J. Hudak (2018). Military genitourinary injuries: past, present, and future. Transl Androl Urol;7(4):646-652.
46. Haley RW, Culver DH, White JW, Morgan WM, Emori TG (1985). The nationwide nosocomial infection rate: a new need for vital statistics. Am J Epidemiol.; 121: 159-167.
47. Krieger JN, Kaiser DL, Wenzel RP (1983). Urinary tract etiology of blood stream infections in hospitalized patients. J Infect Dis.; 148: 57-62.
48. Stamm WE (1991). Catheter-associated urinary tract infections: epidemiology, pathogenesis, and prevention. Am J Med.; 91: 65S-71S.
49. Platt R, Polk F, Bridget M, Rosner B (1982). Mortality associated with nosocomial urinarytract infection. N Engl J Med.; 307: 637-642.
50. Warren JW (1992). Catheter-associated bacteriuria. *Clin Geriatr Med*.; 8:805–19.
51. H K Katsumi, J F Kalisvaart, L D Ronningen, R M Hovey (2010). Urethral Versus Suprapubic Catheter: Choosing the Best Bladder Management for Male Spinal Cord Injury Patients with Indwelling Catheters.Spinal Cord;48(4):325-9.
52. Stephen Y. Liang, Brendan Jackson, Janis Kuhn, Faraz Shaikh, Dana M. Blyth, Timothy J. Whitman, Joseph L. Petfield, M. Leigh Carson, David R. Tribble, Jay R. McDonald (2019). Urinary Tract Infections after Combat-Related Genitourinary Trauma. SURGICAL INFECTIONS Volume 20, Number 8.

53. LY Garcia-Arguello, JC O'Horo, A Farrell, R Blakney, MR Sohail, CT Evans, N Safdar (2016). Infections in the spinal cord-injured population: a systematic review. Spinal Cord, 1–9.
54. Hagen Frickmann, Andreas Podbielski, Bernd Kreikemeyer (2018). Resistant Gram-Negative Bacteria and Diagnostic Point-of-Care Options for the Field Setting during Military Operations. BioMed Research International Volume 9.
55. Heather C. Yun, Dana M. Blyth, Clinton K. Murray (2017). Infectious Complications After Battlefield Injuries: Epidemiology, Prevention, and Treatment. Curr Trauma Rep 3:315–323
56. Rae A. Heitkamp, Ping Li, Katrin Mende, Samandra T. Demons, David R. Tribble, Stuart D. Tyner (2018). Association of Enterococcus spp. with Severe Combat Extremity Injury, Intensive Care, and Polymicrobial Wound Infection. SURGICAL INFECTIONS 19(1).
57. Lindsay E. Nicolle (2000). Urinary Tract Infection in Long-Term–Care Facility Residents. Clinical Infectious Diseases; 31:757–61
58. Uju M.E. DIBUA, Ifeoma S. ONYEMERELA, Emeka I. NWEZE (2014). Frequency, Urinalysis and Susceptibility Profile of Pathogens Causing UrinaryTract Infections in Enugu State, Southeast Nigeria. Rev. Inst. Med. Trop. Sao Paulo. January-February, 56(1):55-59.
59. Mohd Khalid, Mohd Rashid (2018). Alterations in Urine Routine Microscopic Analysis in Patients with Urinary Tract Infection.International Journal of Research and Review; 5(10):360-362