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Original article

Urinary Bacterial Profile and Antibiotic Susceptibility Pattern among Pregnant Women in Eastern Libya

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ABSTRACT

Urinary tract infections, which affect approximately 20% of pregnancies globally, particularly in developing nations with high birth rates like Libya, are a public health concern that complicate pregnancy and are linked to catastrophic maternal, fetal, and neonatal outcomes. Choosing an appropriate therapy depends on current understanding about antibiotics, which is essential for early issue detection and prevention. In this study, antenatal care clinics in several eastern Libyan cities, including "Benghazi, Almarj, Albayda, Shahat, Darna, Alquoba," participated in a cross-sectional investigation to identify the most common causes of UTIs and to ascertain the sensitivity and resistance of antibiotic patterns. From February 9 to April 15, 377 samples were gathered utilizing a standardized questionnaire to obtain data. UTI was diagnosed using mid-stream urine culture on standard culture media. Out of the 377 pregnant women who were included, E. Coli had the greatest infection rate (43.0%), followed by Klebsiella pneumonia (10.3%), Staphylococcus aureus (16.4%), and Staphylococcus saprophyticus (11.4%). The most effective antibiotics were found to be Augmentin (58.9%), Ciprofloxacin (52.6%), and Nitrofurantoin (51.3%), although Azithromycin and Nalidixic acid showed strong resistance to most uropathogens. Our research reveals that urinary tract infections (UTIs) are prevalent among pregnant women in eastern Libya and that bacteria that are extremely resistant to most tested antibiotics are appearing more frequently. These results should cause doctors to reevaluate their treatment strategies in light of antibiotic susceptibility data.

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INTRODUCTION

Urinary Tract Infection (UTI) is a serious health issue that can complicate pregnancy. It refers to a broad range of clinical disorders, from asymptomatic bacterial colonization to inflammation of the bladder or urethra to severe renal pelvis infection or kidney infection with sepsis as a result. Patients with UTI typically manifested with urgency, frequency, painful urination, the need to urinate after urinating, dysuria, pyuria, back pain, and abdominal pain. On the other hand, bacteria in the urinary system could exist even in the absence of symptoms [1].

Pregnant women are more prone to UTI. Many physiological, hormonal, and anatomical changes can occur during pregnancy, such as the relaxation of the uterine smooth muscle brought on by progesterone hormone, the superior and anterior displacement of the bladder by the expanding uterus, the increased concentration of glucose and amino acids in

the urine during pregnancy, the decline in immunity, and the already shorter female urethra near the anus. All of these factors can affect bladder emptying and result in urine stasis, which in turn increased bacterial colonization and causes UTI [2]. Another pregnancy-related UTI risk factors include advanced parity age, multiparity, urinary tract abnormalities, anemia, diabetes mellitus, sexual activity, past UTI history, sickle cell anemia and hygiene practice of each country. Around the world, especially in underdeveloped nations. It accounts for the majority of admission cases in obstetrical wards and has been documented in 20% of pregnant women [3]. Regardless of clinical symptoms, UTI is diagnosed when there is an excess of bacteria in the urinary system (≥105 counts/mL of urine). Symptomatic and asymptomatic bacteriuria have been reported among 17.9% and 13.0% pregnant women, respectively. According to clinical trials, asymptomatic bacteriuria had an 80% to 30% chance of developing into pyelonephritis if left untreated. This risk was lowered by 80% with early detection and appropriate antibiotic therapy [1,2].

UTI in pregnancy is associated with serious obstetric difficulties and unfavorable maternal and perinatal outcomes, such as low birth weight, preterm delivery, preeclampsia, maternal hypertension, spontaneous abortion, caesarian delivery, anemia, amnionitis, intrauterine devolvement retardation [1].

The same species and virulence factors cause UTIs in women, whether or not they are pregnant. The Enterobacteriaceae family is the most frequently detected pathogen, accounting for 80% to 95% of cases. Of these, *E. coli*, with its multidrug resistance strains, is the most frequently isolated bacteria, followed by Staphylococcus species, *Enterobacter* and *Klebsiella*, and *Pseudomonas aeruginosa*. For women who are immunocompromised or have a long-term indwelling catheter, candida species are the primary cause of fungal UTIs [1-4].

Health care providers must estimate the epidemiology of UTI prevalence, risk factors, bacterial isolates, and antibiotic sensitivity in order to recommend appropriate therapies. The most often prescribed antibiotics during pregnancy include Nitrofurantoin, Ciprofloxacin, Gentamicin, Ampicillin, Nalidixic acid, and third-generation Cephalosporines, each of which has a different susceptibility pattern for different uropathogen types[4]. Even though antibiotics are frequently used to treat UTIs, the widespread use of antibiotics administered empirically without conducting appropriate antibiotic susceptibility testing has unavoidably resulted in a significant rise in UTIs caused by drug-resistant bacteria, such as Increasing resistance of gram-negative bacteria and emergence of plasmid-mediated colistin resistance which is the threat for this last-resort antibiotic[5].

Although there is a wealth of published information about UTI during pregnancy from few southern and western Libyan cities as well as other African countries, there is no published data about UTI among women in the east of the country. Therefore, this study aims to determine the bacterial causative agents of UTI, identify their bacterial profile, and ascertain the pattern of antibiotic susceptibility among pregnant women in the eastern region of Libya.

METHODS

Study design

A cross- sectional, prospective study, design was used to conduct the study. The study was carried out in antenatal care unit in different city in Libya (Benghazi, Derna, Almarj, Shahat, Albayda, Al-Quobba), from 28th of December 2023 to 31st of July 2024.

Target and study populations

All pregnant women visit antenatal care unit during the study period and diagnosed with UTI.

Sample size and sampling technique

The number of pregnant women required to be screened from the study population was calculating according to Cochran's formula (n0 = Z2pq/e2) considering 95% confidence level, 5% margin of error and P =0.05 and 43% prevalence rate of UTI. This gave sample size total of 377. A convenient sampling technique was used to enroll consecutive pregnant women attending antenatal care during the study period.

Inclusion criteria

The inclusion criteria were pregnant women symptomatic and asymptomatic for UTI at the study sites who were not on antibiotics treatment during sample collection and who also gave informed consent to participate in the study.

Exclusion criteria

Pregnant women who did not give informed consent and who were on antibiotic treatment during sample collection or have history of Diabetes, Hypertension, Renal stones were excluded.

Data collection

A structured questionnaire was administered to gather information on socio-demographic data and clinical a factor of the pregnant women such as age, education level and trimester of pregnancy.

Data was collected from gynecologists by an online questionnaire using Google forms administered by the researchers. For laboratory analysis, urine samples were sent to designated microbiology laboratories within hospitals or recognized external laboratories in Benghazi, Derna, Almarj, Shahat, Albayda, and Al-Quobba. These laboratories performed bacterial cultures to identify causative uropathogens and their susceptibility patterns. The research team collected and analyzed the results from these recognized laboratories without performing any laboratory work themselves. Data collection spanned from February 9th to June 20th.

RESULTS

A total of 377 pregnant women were included the study. The ages of the pregnant women ranged from 17 to 45 years (Figure 1). More than one third of the women 130(34.5%) were from Derna follow by 70(18.6%) from Shahat, 65(17.2%) from Benghazi, 50(13.3%) from Albayd and 38(10.1%) from Alquba Table 1. More than half of pregnant women had a university degree 210(55.7%), 123(32.6%) had completed high school level of education and 44(11.7%) none educated (Figure 3). Most of pregnant women were in the second trimester (42%), follow by 114(30%) were in first trimester and 104(27.6%) were in third trimester Table 1.

Table 1. Socio-demographic characteristics and clinical variables of pregnant women attending ANC at East of Libya

Characteristics	No	%
Age		
≤25	101	26.8
26-35	209	55.4
≥ 36	67	17.8
Residence		
Albayda	50	13.3
Almarj	24	6.4
Alquba	38	10.1
Benghazi	65	17.2
Darna	130	34.5
Shahat	70	18.6
Level of education		
Non educated	44	11.7
High school	123	32.6
University	210	55.7
Gestational age		
1st Trimester	114	30.2
2nd Trimester	159	42.2
3rd Trimester	104	27.6

Twelve different bacteria were isolated in this study. The majority of the isolates were gram- negatives. *E. coli* was found to be the most frequently isolated 162(43%), followed by *S. aureus 6*2(16.4%), *S. saprophyticus* 43(11.4 %), *K. pneumoniae* 39(10.3%), *Enterococci* 18(4.8%), *Proteus* 12(3.2%), Streptococcus pyogenes 11(2.9%), no growth 10(2.7%), Beta hemolytic *streptococcus* 7(1.9%), *Enterobacter* 6(1.6%), *P Pseudomonas* 5(1.3%) and 2(0.5%) Table 2.

Table 2. Bacterial profile isolated from pregnant women attending ANC at East of Libya.

Bacterial isolates	No	%
E. coli	162	43.0
Staphylococcus aureus	62	16.4
Staphylococcus saprophyticus	43	11.4
Klebsiella pneumonia	39	10.3
Enterococci	18	4.8
Proteus	12	3.2
Streptococcus pyogenes	11	2.9
No growth	10	2.7
Beta hemolytic streptococcus	7	1.9
Enterobacter	6	1.6
Pseudomonas	5	1.3
Staphylococcus haemolyticus	2	0.5

Antimicrobial susceptibility pattern of GNB

Gram-negative bacteria showed a high level of sensitivity to Augmentin (58.9%), Ciprofloxacin (52.6%) and Nitrofurantoin (51.3%). *E. coli* dominant was relatively sensitive to Augmentin (64.8%), Nitrofurantoin (56.7%), Cefixime (24.1%).

K. pneumonia was sensitive to Azithromycin (76.9%), Ciprofloxacin (56.4%), and Erythromycin (20.5%). Proteus was equally sensitive to Nitrofurantoin and Ciprofloxacin with rate of 50%. Enterobacter was completely sensitive to Ampicillin (100%), Ciprofloxacin and Augmentin (66.6%) each. Pseudomonas was fully sensitive to Augmentin (100%), Erythromycin and Ciprofloxacin (60%) each. ut gram-negative isolates showed a high-level resistance against Cefixime (26.7%), Nalidixic acid (24%) and Erythromycin (22.3%). However, it was low resistant to Clindamycin (0.9%) and Augmentin (0.5%). *E. coli* was resistant to Nalidixic acid (24.7%), Azithromycin (24.1%), and Ciprofloxacin (19.7%). Klebsiella was highly resistant to Nitrofurantoin (38.5%), Cefixime (35.8%), Erythromycin and Nalidixic acid (25.6%) each. Proteus were resistant to Cefixime (58.3%) and Ciprofloxacin (50%). Enterobacter was highly resistant to Septrin (50%) and Erythromycin (33,3%). Pseudomonas was resistant to Nalidixic acid, Cefixime, Ciprofloxacin Table 3.

Antimicrobial susceptibility pattern of GPB

Gram-positive isolates were highly susceptible to Augmentin (65.7%), Nitrofurantoin (57.3%) and Gentamicin (32.8%). Staphylococcus aureus dominant was relatively sensitive to Augmentin (62.9%) and Cefixime (37.1%). Staphylococcus saprophyticus was relatively sensitive to Augmentin (62.7%), and Cefixime (39.5%). Streptococcus pyogenes was highly sensitive to Cefixime (72.7%), Nitrofurantoin and Augmentin (54.5%) each. Enterococci was sensitive to Augmentin (72.2%), Cefixime (55.5%) and Nitrofurantoin (50%). Beta hemolytic streptococcus was sensitive to Azithromycin, Cefixime and Vancomycin (42.8%) each. Staphylococcus haemolyticus was fully (100%) resistant to Azithromycin, Nalidixic acid, Cefixime, Doxycycline. But gram-positive isolates showed a high-level resistance against Augmentin (65.7%), Nitrofurantoin (57.3%), and Cefixime (42.6%). However, it was lowly resistant to Azithromycin (17.4%), and Erythromycin (9.7%). Staphylococcus aureus dominant was highly resistant to Azithromycin (35.5%), and Nalidixic acid (29%). Staphylococcus saprophyticus was highly resistant to Azithromycin (60.4%), and Erythromycin (30.2%). Stryptococcus pyogenes was highly resistant to Augmentin (54.5%), Ciprofloxacin and Nalidixic acid (27.3%) each. Enterococci was highly resistant to Nitrofurantoin (33.3%), and Erythromycin (22.2%). Beta hemolytic streptococcus was resistant to Azithromycin, Cefixime and Vancomycin (42.8% each). Staphylococcus haemolyticus fully (100%) resistant to Septrin Table 4.

Table 3. Antimicrobial Susceptibility pattern of gram-negative bacteria isolated from urine culture of pregnant women in Eastern Libya. [1]

Isolates	AST Pattern	Antimicrobial agents tested																					
		NI/F	LEV	AZM	E	NA	CFX	LCM	NEO	DO	TS/SXT	AMC	CIP	AK	AML	SXT	CD/DA	PN	VA	CN	TE	Cephaloxin	CAM
E. coli (162)	S	92	31	29	27	25	39	0	0	11	0	105	83	7	18	8	3	3	9	32	7	6	3
	R	20	27	39	35	40	37	4	4	17	15	0	32	27	12	15	1	5	12	12	11	11	1
Klebsiella (39)	S	10	12	30	8	5	7	0	0	4	0	13	22	2	0	3	0	2	1	4	1	2	1
	R	15	9	9	10	10	14	2	2	6	4	0	9	6	5	6	0	3	1	2	2	0	3
Proteus (12)	S	6	4	4	1	3	0	0	0	1	0	5	6	1	0	0	0	0	2	1	0	1	1
	R	3	2	2	3	2	7	0	0	3	1	2	6	5	2	1	0	1	0	0	0	0	0
Enterobacter (6)	S	3	0	3	0	3	2	0	0	3	1	4	4	0	1	0	0	6	0	1	0	3	3
	R	0	0	1	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1
Pseudomonas (5)	S	1	0	2	3	1	1	0	0	0	0	5	3	1	1	1	0	1	0	0	0	1	0
	R	1	1	1	0	2	2	0	0	0	0	1	2	0	0	0	1	0	0	0	0	1	2

[1] Nitrofurantoin , Levofloxacin, Azithromycin, Erythromycin, Nalidixic acid, Cefixime, Lincomycin, Neomycin, Doxycycline, Trimethoprim sulfamethoxazole, Augmentin , Ciprofloxacin, Amikacin, Amoxicillin, Septrin, Clindamycin, Ampicillin, Vancomycin, Gentamycin, Tetracycline, Cephaloxin, Clarythromycin.

Table 4. Antimicrobial susceptibility pattern of gram-positive bacteria isolated from urine culture of pregnant women in Eastern Libya.[2]

Isolates	AST Pattern	Antimicrobial agents tested																					
		NI/F	LEV	AZM	E	NA	CFX	LCM	NEO	DO	TS/SXT	AMC	CIP	AK	AML	SXT	CD/DA	PN	VA	CN	TE	Cephaloxin	CAM
Staphylococcus aureus (62)	S	31	9	7	14	7	23	0	0	17	0	39	29	6	1	8	0	1	3	20	7	2	9
	R	15	6	22	13	18	11	0	0	5	7	12	14	3	7	1	0	4	2	8	2	2	2
Staphylococcus saprophyticus (43)	S	15	4	4	0	4	17	0	0	4	0	27	20	0	4	2	0	2	7	22	1	0	1
	R	5	3	26	13	14	9	1	1	1	0	1	10	3	7	1	0	3	0	3	0	0	0
Streptococcus pyogenes (11)	S	6	1	3	0	0	8	0	0	0	0	6	2	0	0	0	2	0	0	2	0	2	0
	R	2	5	0	1	3	0	0	0	0	1	6	3	0	0	1	0	2	2	0	0	0	0
Enterococci (18)	S	9	0	5	0	0	10	0	0	4		13	2	1	0	0	2	0	0	0	0	0	0
	R	6	0	2	4	1	2	0	1	0	0	2	3	5	0	1	1	0	0	3	0	0	0
Beta hemolytic streptococcus (7)	S	0	0	4	0	1	1	0	0	1	2	7	4	0	0	3	2	0	0	3	1	0	1
	R	1	0	3	0	0	3	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0
Staphylococcus hemolytics (2)	S	0	0	2	0	2	2	0	0	2	0	2	2	0	0	0	2	0	0	0	0	2	2
	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0

[2] Nitrofurantoin , Levofloxacin, Azithromycin, Erythromycin, Nalidixic acid, Cefixime, Lincomycin, Neomycin, Doxycycline, Trimethoprim sulfamethoxazole, Augmentin , Ciprofloxacin, Amikacin, Amoxicillin, Septrin, Clindamycin, Ampicillin, Vancomycin, Gentamycin, Tetracycline, Cephaloxin, Clarythromycin.

DISCUSSION

A large proportion of the mothers (82.2%) who had UTI belonged to the age group 17-35 years; this age group is the peak reproductive period in most societies. This finding is inconsistent with the result obtained from previously reported in Libya [7]. The observation in this study is consistent with reports of other studies from different countries. In India, Dash *et al*., [8]reported 55.4% in age group 18-37 years, in Cameroon, Akoachere *et al.,* [9] reported 59.1% in age group 20-39 years. The susceptibility of young women to UTI has been demonstrated on the basis of anatomical or physical abnormalities and some behavioral [10-12]. Herein, in this study observed that pregnant women in their second trimester of pregnancy had the highest prevalence of UTI (42%) followed by the third and first trimesters which is in agreement with the findings from previously reported in Libya [7] and from Masinde *et al.,* [13] and Obirikorang *et al.*,[14]. It is however contrary to the findings of Turpin *et al.*,[15] who reported a high percentage of UTIs during first and early second trimesters. The high prevalence of UTIs in the second trimester can partially be attributed to the rapid changes in the physiology and immunology of pregnant women and due to the frequency of UTIs tests during this phase. This study revealed high prevalence of UTI in pregnant mothers with university degree of education compared to other levels of education. There is a possibility that this category of mothers relies on self-medication hence the high resistances exhibited. In this study, the most common bacterial isolates from midstream urine samples of pregnant women were *E. coli* (43%) followed by *S. aureus* (16.4%) and *S. saprophyticus* (11.4 %). This finding is most consistent with many of the previous studies in Libya, which determined the *E. coli* are the most common urinary tract associated bacteria [16-18,7]

Also, similar to other findings in different countries in Egypt [19-21], in Tanzania, Sudan and Ethiopia [13,3,22]. Difficulty in maintaining personal hygiene during pregnancy as well as the anatomical and functional changes that occur during this period may increase the risk of acquiring UTIs from *E. coli* being a commensal of the bowel. *K. pneumonia* was the second most prevalent uropathogen similar to related studies in Tanzania [13,23]. Among Gram-positive organisms, *S. aureus* was the comments followed by and *S. saprophyticus* and *Enterococcus*. The differences and similarities in the distribution of the pathogens causing UTIs may be due to different environmental conditions, host factors and practices such as health care, education programs, socio-economic status and hygiene practices in each country. Other studies of asymptomatic bacteriuria bacteriology patterns among pregnant women worldwide reported a similar finding with the predominance of gram-negative organisms, especially *E. coli* in Ethiopia, Iran, Bangladesh, Uganda, Indian [24-28]. In this study, gram-negative bacterial isolates were more prevalent than gram-positive bacterial isolates (59.4% vs. 37.9%). The findings were reported Addis Ababa (60% vs. 40%) [29], Gondar (58.4% vs. 41.6%) [30]. The most prevalent gram-negative uropathogen identified in this study was *E. coli* (43%) followed by *Klebsiella* (17.4%) and *Proteus* (5.3%). *E. coli* was also identified in other nearly similar studies in Addis Ababa (44%), Sudan (42.4%), Bahirdar (45.7%) and Gondar (47.5%) [29-31]. In this study, it was higher than other studies in Dire Dawa (34.6%) and Bale Goba (27.3%) [32-33]. The antibiotic sensitivity studies conducted on the isolated urinary tract causative bacterial agent in the present study revealed that Augmentin, Ciprofloxacin and Nitrofurantoin were relatively effective antibiotic against gram-negative uropathogen. However, Cefixime, Nalidixic acid and Erythromycin exhibited a high level of resistance by gram-negative isolates. This finding is in agreement with the study conducted in Gondar, Addis Ababa, Sudan, Nigeria, Dire Dawa, and Bale Goba [29-30,3,32,34-35].

On the other hand, gram-positive bacteria of uropathogens in the current studies were sensitive to antibiotics such as; Augmentin, Nitrofurantoin, Cefixime, Ciprofloxacin and Gentamicin. Augmentin and Nitrofurantoin which is also in agreement with the findings of some other studies in Ethiopia [29,36]. According to our study, about two-thirds of gram-positive isolates were sensitive to Ciprofloxacin, Nitrofurantoin, but Ceftriaxone was ineffective against majority of the isolates with a resistance rate of 100%. *S. aureus* and *S.saprophyticus* showed nearly the same susceptibility and resistance pattern to the commonly used antibiotics with an exception that the latter being additionally resistant to Erythromycin. Moreover *S.haemolyticus* reported to be fully resistance to the common antimicrobials.

Cefixime showed less resistance rate to *Klebsiella pneumonia* compared with Proteus species with a resistance rate of 35.8% and 58.3% respectively, therefore a cause of concern. The alarming finding in this study is the increased resistance of isolated uropathogens to the some of the commonly used antimicrobials including Nitrofurantoin, the first-line therapy for UTI in pregnancy. Inadequate therapy and increased drug resistance can result from the misuse of antibiotics. The inappropriate use of antibiotics in low-income nations may be caused by a lack of adequate drug knowledge, the unavailability or inaccessibility of therapy guidelines, the availability of antibiotics without a prescription, or the prescription of antibiotics by unskilled medical professionals. Thus, in order to combat increasing antimicrobial resistance and update the empirical treatment guide, it is crucial to continuously monitor the frequency of infections and the patterns of antibiotic resistance.

CONCLUSION

Based on our study, Gram-negative bacteria including *E. coli* and its multidrug resistant strains are the most frequently encountered uropathogens in UTI among pregnant women in Eastern region of Libya, followed by *staphylococcus aureus* and *staphylococcus saprophyticus*, while the lowest was *staphylococcus haemolyticus*. *E. coli* was highly sensitive to Augmentin, Nitrofurantoin, Ciprofloxacin, Cefixime. However due to emergence of resistance to the commonly used antibiotics, the choice of antimicrobial therapy in pregnancy should be preceded by urine culture and antibiotic susceptibility testing, and fetomaternal safety should be considered.

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Conflicts of Interest

The authors declare no conflicts of interest.

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ملف البكتيريا البولية ونمط حساسية المضادات الحيوية بين النساء الحوامل في شرق ليبيا

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المستخلص

تعد عدوى المسالك البولية، التي تؤثر على ما يقرب من 20٪ من حالات الحمل على مستوى العالم، وخاصة في الدول النامية ذات معدلات المواليد المرتفعة مثل ليبيا، مصدر قلق للصحة العامة يعقد الحمل ويرتبط بنتائج كارثية للأم والجنين والوليد. يعتمد اختيار العلاج المناسب على الفهم الحالي للمضادات الحيوية، وهو أمر ضروري للكشف المبكر عن المشكلة والوقاية منها. في هذه الدراسة، شاركت عيادات رعاية ما قبل الولادة في عدة مدن شرق ليبيا، بما في ذلك "بنغازي، المرج، البيضاء، شحات، درنة، القبة"، في تحقيق مقطعي لتحديد الأسباب الأكثر شيوعًا لالتهابات المسالك البولية والتأكد من حساسية ومقاومة أنماط المضادات الحيوية. من 9 فبراير إلى 15 أبريل، تم جمع 377 عينة باستخدام استبيان موحد للحصول على البيانات. تم تشخيص التهاب المسالك البولية باستخدام مزرعة منتصف مجرى البول على وسائط زراعة قياسية. من بين 377 امرأة حامل تم تضمينهن، كان معدل الإصابة بـ E. Coli هو الأعلى (43.0٪)، تليها Klebsiella pneumonia (10.3٪)، Staphylococcus aureus (16.4٪)، و Staphylococcus saprophyticus (11.4٪). وقد تبين أن أكثر المضادات الحيوية فعالية هي أوغمنتين (58.9%)، وسيبروفلوكساسين (52.6%)، ونيتروفورانتوين (51.3%)، على الرغم من أن أزيثروميسين وحمض النالديكسيك أظهرا مقاومة قوية لمعظم مسببات الأمراض البولية. وتكشف أبحاثنا أن التهابات المسالك البولية منتشرة بين النساء الحوامل في شرق ليبيا وأن البكتيريا شديدة المقاومة لمعظم المضادات الحيوية المختبرة تظهر بشكل متكرر. وينبغي أن تدفع هذه النتائج الأطباء إلى إعادة تقييم استراتيجيات علاجهم في ضوء بيانات حساسية المضادات الحيوية.

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