ECRONICON OPEN ACCESS

MICROBIOLOGY
Research Article

Prevalence and Drug Susceptibility of Microorganism Isolated from Urinary and Genital Tracts of Pregnant Women in Jordan

Battikhi MN[1]* and Battikhi QG[2]

Battikhi Central Laboratories, Jordan

Medical Laboratory for research and technology Prince Mohammed St. Amman-Jordan

***Corresponding Author:** Moh'd Nizar Battikhi, Battikhi Central Laboratory, 1017-1645 De Maisonneuve O, Montreal H3H 2N3, QC, Canada.

Received: June 13, 2015; **Published:** September 16, 2015

Abstract

This study focused on Identity and drug susceptibility of bacteria isolated from urinary and genital tracts of pregnant women in Jordan. Three hundred and seventeen pregnant women were referred. Midstream urine samples were collected in the laboratory while high virginal swabs (HVS) were taken by the physician in clinics. Two hundred and fifteen samples revealed positive growth out of which 136 (63.3%) and 79 (36.7%) for urine and HVS respectively. The rate of urinary tract Infection (UTI) was significantly higher than genital tract infection ($P < 0.05$). *Escherichia coli* revealed the highest prevalence 97 (34.4%) in urinary tract, while *Staphylococcus aureus* was the highest isolates in genital tract 74 (31.9%). *S.aureus* and coliforms showed the next highest rates 53 (18.8%) and 51 (18.1%) respectively followed by *Klebsiella pneumonia*. 41 (14.5%) in urine. Other bacterial species include *Staphylococcus epidermidis, Streptococcus feacialis, Proteus mirabilis* and *Bateriodes* were isolated with various prevalence rate. *Candida albicans* showed high rate for HVS and urine 78.0 (34.1%) and 12 (4.2%) respectively while *Lactobacillus spp*. was solely isolated from HVS.

Meropenem and norfloxacin showed 100.0% and 99.3% activity for urine and HVS isolates respectively. Followed by ipenim 100.0%, 97.4%, levoloxacin 98.9%, 99.3%, They were the most active antibiotics, followed by tobramycin (95.5%, 92.2%), Cefoxitin (89.5%, 94.1%) and ciprofloxacin (89.5%, 86.2%). There was no statistical significant variation in drug susceptibility between isolate from urine and HVS.

The percentage of multi drug resistant microorganisms was higher in urine samples than HVS (61.1%) and (57.1%) respectively. The rate of multidrug resistance in both samples is high (> 50%). These results are worrisome and essential care should be taken in pregnancy unit and drug prescribing policy should be monitored and updated.

Keywords: *Prevalence; Antibiotic resistant; Urinary tract; Genital tract; Pregnant Women*

Introduction

Pregnancy doesn't cause urinary tract infection (UTI) however; the physical changes occur during pregnancy increase susceptibility of pregnant women to infection.

The complication caused by urigenital infection and specifically by multidrug resistant microbes can cause serious problems during pregnancy [1-5].

Pregnant women tend to visit hospitals and gynecology clinic for routine checkup regardless of sign of infections [4,6]. Bacteruria, cystitis, vaginitis and pyelonephritis are the most common cause of uriginital infections [4,7]. Hypertension, still birth, abortion, preterm labour and thrombosis are the most cause of asymptomatic infection in pregnant women [6,8,9]. Pyelonephritis could cause significant maternal and fetal morbidity and mortality [3,10]. Other physiological changes during pregnancy such as hormonal changes provide the

ideal environment for UTI-causing bacteria (*Escherichia coli*) and increase rate of infection, like wise vagina of the pregnant women work as niche for bacterial growth and Candida due to moisture habitat and rich glycogen content [11]. Although most of the vaginal bacteria are not pathogenic unless they have chance to overgrown in numbers or in case of an abrasion they will induce infection. Due to these facts pregnant women will be more susceptible to infection. Routine visits to antenatal clinics and hospital where nosocomial infection rate is high will expose pregnant women to microbes and increase chance of infection. This contact has been reported to cause serious problem in developing countries where drug prescribing policy is not controlled and random antibiotic treatment developed multidrug resistant bacteria (MDR) making infection treatment difficult task and therefore will enhance threat to both mother and fetus and will reduce rate of using safe antibiotic and hence treatment successes hard to achieve and infection impossible to eliminate [4,12-14]. Many studies focused on (MDR) bacteria developed in hospital and clinic especially methicillin resistant *Staphylococcus aureus* which create one of the major serious problems in treating pregnant women exposed to such environment. The demographic situation plays an important role in reporting gram negative and gram positive MDR showing increase rate of gram negative MDR where gram positive MDR suppose to be dominant [18]. These finding illustrate an urgent indication for a better drug surveillance control system [4,15]. In both cases rate of MDR is high leading to possible formation of modified MDR strains by either intrinsic manner or by mutation [15,16] specifically in underdeveloped countries where prescribing antibiotics is not controlled therefore better surveillance drug policy is required [7,17].

Most studies focused on prevalence of UTI with less concern of genital tract infection. The scope of this study is to lay out the prevalence of microbes, identity and drug resistant pattern for isolates from both urinary and genital tracts in Jordanian pregnant women [9].

Materials and Methods

A total of 317 patients were referred to the laboratories. Med stream urine specimens were collected in the laboratory in wide capped sterile urine containers while HVS sent to the laboratories after been collected by Obstetricians within twenty minutes. Microbiological studies proceeded as soon as samples reached laboratory. Delayed samples were rejected if they exceed recommended time Collected urine specimens were cultured immediately using blood and MacConkey agar plates to determine the pattern of disease, causative organisms. Samples were inoculated in duplicate as epticalcy and incubated aerobically at 37°C. Colony forming units were counted 24 hours later, and c if ≥ 100,000/ml, antimicrobial sensitivity studies were then performed and read after a further 24 hours.

Nutrient, blood, Chocolate and MacConkey agar media were used for HVS. Plates were inoculated in duplicate aseptically and were incubated aerobically at 37°C for 24 hours. Microorganism identification and characterization using routine morphological and biochemical methods were applied according to [18].

Mueller Hinton Agar (MHA) was the selected medium for sensitivity test. Commercial multidisc and single sensitivity discs were used for the susceptibility test following method described by [19]. Antibiotics discs; amoxicillin (AMX) 25 µg, augmentin® (AUG) 30 µg, cefoxitin (FOX) 30 µg ceftriazone (CRO) 30 µg, cotrimoxazole (COT), ciprofloxacin (CPX) 10 µg, gentamycin (GEN) 10 µg, imipenim (IPM)10 µg, levofloxacine (LEV) 30 µg, nalidixic acid (NA 30 µg), nitrofurantoin (NIT) 20 µg, Norofloxacin (NOR) 30 µg, Pefloxacin (PFL) 5 µg, Tobromycin (TOB) 10 µg were used. Zone of inhibition measured to determine the level of susceptibility of isolates to the antibiotics. Data obtained in this study were analyzed using SPSS version16.0

Results

A total of 317 patients were referred to the laboratory for urine and HVS culture out of which 250 revealed microbial growth giving prevalence rate of 136, 63, 3% and 79, 36.7% for urine and HVS sample respectively. The rate of UTI was significantly higher than genital tract infection ($P < 0.05$). The prevalence and the rate of positive culture revealed single isolate was 90, 78.3% and 56, 69.1% for urine and HVS respectively however, the number and rate of samples showed mixed growth culture was 25, 21.7% and 20 (24.6%) for urine and HVS samples respectively.

E.coli was the most predominant organism with prevalence rate of 97, 34.4% in urine samples while *S.aureus* showed the highest prevalence rate 74, 31.9% in HVS followed by *C.albicans* 67(28.8%). Summary of the results presented in Table 1.

Organism	Urine		HVS		Total	
	Freq. of occurrence	% prevlence	Freq. of occurrence	% Prevalence	Freq. of occurrence	% Prevalence
E.coli	97	34.4	33	14.2	130	25.3
S. aureus	53	18.8	74	31.9	127	24.7
Coliforms	51	18.1	9	3.9	60	11.7
K. pneumonia	41	14.5	0	0	41	7.9
S. epiderms	11	3.9	19	8.2	30	5.8
S. faecialis	6	2.1	8	3.4	14	2.7
Bacteriodes	4	1.4	0	0	4	0.8
P. mirabilis	3	1.1	0	0	3	0.6
P. aeuroginosa	4	1.4	6	2.5	10.0	2.0
Lactobacillus	0	0.0	4	1.8	4	0.8
C. albican	12	4.3	79	34.1	91	17.7
Total	282	100	232	100	514	100

Table 1 : *Prevalence of various isolates from Urine and HVS of pregnant women in Jordan.*

Meropenem and norfloxacin showed 100.0% and 99.3% activity for urine and HVS isolates respectively followed by ipipenim 100.0%, 97.4%, levoloxacin 98.9%, 99.3%, They were the most active antibiotics. Followed by tobramycin 95.5%, 92.2%. Cefoxitin 89.5%, 94.1%, and ciprofloxacin 89.5%, 86.2%. There was no statistical significant variation in drug susceptibility between isolate from urine and HVS.

In this study multidrug resistance (MDR) is described as the capacity of isolate to resist minimum concentration of certain drug. The rate of MDR in urine sample was higher than HVS sample 61.1%, 57.1% respectively Table 4 and 5 however, there was no statistical significant difference noticed, this indicate that UTI was more expose to drug treatment than genital tract infection.

The rate of multidrug resistance in both samples is high (> 50%). These results are worrisome and essential care should be taken in pregnancy unit and efficient drug prescribing policy should be explored.

Discussion and Conclusion

Results in this study showed statistical significant ($p < 0.05$) higher microbial infections in urine sample than HVS which might be related to site of collection however, mixed cultures of *Candida albicans (C.albicans)* with other microorganisms were found higher in HVS Prevalence of *Candida albicans* (34.1 %) in HVS samples is higher than urine because female genital tract has suitable condition supporting growth of different types of aerobic and anaerobic bacteria as well as *C. albicans* [20]. Occurrence of mixed cultures in our study samples is consistent with previous report [21] stated that antibiotic selection treatment policy is difficult, especially in the developing countries, where inadequate health services strategy, uncontrolled drug prescriptions surveillance, and improper treatment strategies all lead for development of microbial resistance.

The overall prevalence 45.6 %,32.3% for urine and HVS respectively found in this study is rather high however, it is in similar to 48.0% rate reported by [22] and 45.3% rate reported by (4,23) for urine samples. The HVS prevalence rate is not as high as but rather close to the (40.1%) study reported by [4] however, it is inconsistent with other study showing prevalence rate of 12.7% [24]. This is quite understandable due to different geographical location and social and economical status of pregnant women.

E. coli was the most prevalent organism followed by *S.aureus* in urine samples however; *S.aureus* was the most prevalent bacterial isolate from genital tract followed by *E. coli*. Table1.This result agree with other studies [4,9]. Although organisms isolated in this study showed lower prevalence in uriginital infection which is consistent with other study [18,24] however, their prevalence and resistant pattern should be taken in consideration.

E.coli, *K. pneumonia* and *Ent. faecalis* also showed a resistance pattern > 50% for most of drug used as first line of treatment. This is consistent with other study [4,15] however, it is inconsistent with the sensitivity rates (75% and 74%) for *E. coli* and *K. pneumonia* to antibiotics reported by Momoh ARM., *el al*. [] and Akerele., *et al*. [].

Ciprofloxacin showed activity rate of 89.5% and 86.2%, nalidixic acid showed activity rate 88.4% and 85.0% for urine and HVS respectively. Other antibiotics explicit high activity, ofloxacin 87.7% and 82.4%, pefloxacin 80.2% and 72.5% for isolates from the respective samples without showing significant statistical variation. The results of antibiotics activity agreed with other studies [4,15].

The high activity of flouroquinolones in this study is rather interesting for both urine and HVS samples Table 2 and 3. It is not surprising due to the unique action of the drug on DNA inhibition and as documented flouroquinolones are newer drugs with mode of action central on inhibition of the DNA [25-27]. Adding to that flouroquinolones groups are relatively expensive therefore patients exposure to the drug is low [4].

Nitrofurantoin, augmentin® ceftriazone and gentamicin showed moderate effective range on urine and HVS isolates 45.0% to 55.0%. There was no significant statistical variation in drugs susceptibility of urine and HVS isolates to augmentin® and ceftriazone, which is in agreement with other study [4] however, nitrofurantoin showed 57.3% and 54.9% to urine and HVS respectively with no significant statistical variation. This result is slightly different from other study [4] reported higher activity for urine isolates over vaginal isolates. This might be due to geographical difference between countries and their antibiotics prescription policy.

Activity of gentamicin 47.1% and 44.7% for vaginal and urine sample respectively with no statistical significant variation however, it is in agreement with other study where effect of gentamycin in treating vaginal infection was higher than UTI [4]. This indicate rational use of gentamicin in genital infection treatment in Jordanian pregnant women as first line of treatment for the fact that gentamicin is safe to treat pregnant women [28].

Amoxicillin showed very low efficacy (< 30%) this is not surprising result since amoxicillin was used widely for treatment of various type of infection caused formation of drug resistant strains. This result is in agreement with other studies showed high resistance microbes to amoxicillin [7,22]. Therefore, it is not recommended to use amoxacillin for UTI and vaginal infection.

The results obtained in this study show clearly the disadvantages of inappropriate use of antimicrobial agents obviously minimize options of using selective drugs for future uriginital infection treatment. The high resistant of urine isolates and the formation of MDR strains can be explained by temovedhe fact that the urine isolates were exposed to consistently higher urine concentrations of antimicrobial agents, compared to low antibiotic concentration of HVS. Urine samples also showed higher rate of multidrug resistance than HVS isolates 61.1% and 57.1 respectively, with significant statistical variation ($P < 0.05$) due to different location of isolates [1-3].

There was no specific pattern of drug resistance for urine and HVS isolates however, *S.aureus* in both specimen interestingly showed the highest multidrug resistance of 73.6% and 63.5% (Mean = 68.6%), followed by *P.auregonosa* 75.0% and 66.6% (Mean = 70.8%). E. coli showed 67.0% and 60.6% (Mean = 63.8) resistance rate. The high resistance of *S.aureus* is not surprising because the bacterium is documented for exhibit high resistance rate [3,5,6] since it is a commonly found in hospital environment, antenatal clinics and community [29]. The prevalence of multidrug resistant *S.aureus* in this study demonstrate a resistance profile of > 50% to almost half of the antibiotics tested, part of these selected antibiotic usually used as first line treatment. The resistance scheme of S.aureus is consistent

with other studies [15,30] where S.aureus resistant profile in clinics and hospital was documented and prevalence of methicillin resistance *S.aureus* strains were stated [15,30,31].

Bacteria	*E.coli*	*S. aureus*	*Coliforms*	*K. pneumonia*	*S. epidermi*	*S. faecialis*	*Bacteriode*	*P. mirabilis*	*P. aeuroginosa*	Total
No/% susceptibility	97	53	51	41	11	6	4	3	2	268
AUG 30 ug	48 49.4	22 41.5	39 76.5	16 40.0	9 81.8	5 83.3	3 75.0	2 66.6	1 50.0	145 54.1
CRO 30 ug	43 44.3	20 37.7	45 88.2	26 63.4	7 63.3	6 100.0	4 100.0	2 66.5.	2 100.0.	155 57.8
NIT20 ug	51 52.5	35 66.0	38 74.5	27 65.8	8 72.3	2 33.0	2 50.0	1 33.3	0.00 0.0	164 57.3
GEN 10 ug	30 30.9	13 24.5	40 78.4	19 46.3	9 81.8	4 66.0	3 75.0	1 33.3	1 50.0	120 44.7
COT 25	40 41.2	43 81.1	46 90.1	41 100.0	10 90.9	5 83.3	2 50.0	1 33.50	2 100.0	139 51.8
OFL 5 ug	69 70.1	48 90.6	49 96.1	30 73.2	10 90.9	4 66.6	4 100.0	20 66.6.	1 50.0	235 87.7
AMX26	3 3.0	23 43.3	25 49.0	13 11.7	5 45.4	1 16.6	3 75.0	1 33.3	0 0.0	79 29.5
CIP 5 ug	97 100.0	50 94.3	47 92.2	37 90.2	0 100.0	0 100.0	4 100.0	3 100.0	2 100.0	240 89.5
PF5 ug	65 67.0	48 90.6	48 94.1	34 82.9	9 81.8	5 83.3	3 75.0	2 66.6	1 50.0	215 80.2
NA30 ug	76 78.3	51 96.2	46 91.1	41 100.0	11 100.0	4 66.6	4 100.0	3 100.0	1 50.0	237 88.4
LEV10 ug	97 100.0	51 96.2	51 100.0	41 100.0	11 100.0	5 83.3	4 100.0	3 100.0	2 100.0	265 98.9
IPM30	97 100.0	53 100.0	51 100.0	41 100.0	11 100.0	6 100.0	4 100.0	3 100.0	2 100.0	268 100.0
NOR 1o ug	93 95.8	46 86.8	51 100.0	38 92.6	9 81.8	5 83.3	3 75.0	3 100.0	2 100.0	250 93.3
FOX30 ug	91 93.9	43 81.1	46 90.2	37 92.2	10 90.9	5 83.0	4 100.0	3 100.0	1 50.0	240 89.6
MEM 10ug	97 100.0	53 100.0	51 100.0	41 100.0	11 100.0	6 100.0	4 100.0	3 100.0	2 100.0	268 100.0
TOB10 ug	97 100.0	46 86.8	51 100.0	36 87.0	11 90.9	5 83.3	2 50.0	3 100.0	1 50.0	256 95.5

Table 2: *Susceptibility of urine isolates from pregnant women in Jordan.*

Bacteria	*E.coli*	*S. aureus*	*Coliforms*	*K. pneumonia*	*S. epidermi*	*S. faecialis*	*Bacteriode*	*P. mirabilis*	*P. aeuroginosa*	Total
No/% susceptibility	33	74	9	2	17	8	0	4	6	153
AUG 30 ug	16 48.4	34 44.5	4 44.4	1 50.0	7 41.2	6 75.8	83.3	3 75.0	3 50.0	74 48.3
CRO 30 ug	18 54.5	32 43.2	4 33.3	2 100.0	11 64.7	5 62.5	100.0	4 100.0	6 100.0	82 53.6
NIT20 ug	19 57.6	38 51.3	6 66.6	1 50.0	11 64.7	6 75.0	33.0	2 50.0	1 16.0	84 54.9
GEN 10 ug	12 36.0	34 46.0	2 22.2	1 50.0	12 70.5	6 75.0	66.0	3 75.0	2 33.3	72 47.1
COT 25	15 45.5	29 39.2	7 77.7	2 100.0	17 100.0	7 87.5	83.3	2 50.0	6 100.0	85 55.5
OFL 5 ug	20 60.6	66 89.1.	8 88.8	2 100.0	13 76.5	7 87.5	66.6	4 100.0	6 100.0	126 82.4
AMX26	1 3.0	3 4.1	4 44.4	2 100.0	2 11.7	4 50.0	16.6	3 75.0	0.0 0.0	19 12.4
CIP 5 ug	27 81.8	62 83.8	8 88.8	2 100.0	15 88.2	8 100.0	5 100.0	4 100.0	6 100.0	132 86.2
PF5 ug	23 69.6	49 66.2	8 88.8	2 100.0	14 82.4	8 100.0	83.3	3 75.0	4 66.6	111 72.5
NA30 ug	26 78.8	64 84.6	8 88.8	1 50.0	17 100.0	8 100.0	66.6	3 75.0	3 50.0	130 85.0
LEV10 ug	33 100.0	74 100.0	9 100.0	2 100.0	17 100.0	8 100.0	83.3	4 100.0	6 100.0	153 99.3
IPM30	33 100.0	70 94.5	9 100.0	2 100.0	17 100.0	8 100.0	83.0	4 100.0	6 100.0	149 97.4
NOR 1o ug	33 100.0	74 100.0	9 100.0	2 100.0	16 94.1	8 100.0	100.0	4 100.0	6 100.0	152 99.3
FOX30 ug	30 91.0	74 100.0	8 88.8	2 100.0	15 88.2	8 100.0	83.3	3 75.0	4 66.6	144 94.1
MEM 10ug	33 100.0	74 100.0	9 100.0	2 100.0	17 100.0	8 100.0	100.0	4 100.0	6 100.0	153 100.0
TOB10 ug	33 100.0	70 94.6	9 100.0	2 100.0	15 88.2	7 87.5	66.0	3 75.0	2 33.3	141 92.2

Table 3: *Susceptibility of HVS isolate from pregnant women in Jordan.*

The resistant of *P.aeruginosa* to antibiotics is well documented, our results showed low effect of antibiotics on *P.aeruginosa* except for few selective group, flouroquinolones showed high activity rate which agree with other studies [15,32] however, recommendation for surveillance on prescribing such antibiotic is highly recommend.

The result of this study showed low prevalence rate for *E.coli* and *E. faecalis* although, these two microbes showed > 60.0% and > 50% resistant pattern respectively which agree with other study [4] but disagreed to sensitivity rate of 75% and 74% reported by [3]. This can be explained by the fact that theses isolates have been exposed to various antibiotic concentrations in hospital for period of time leading to acquisition of antibiotic resistance by different mechanisms. Immense concern is recommended for treatment of future

infection caused by these two organisms. Lactobacillus susceptibility to antibiotics was not of our interest in this study due to normal presence of this microorganism in women genital tract.

Generally, the level of multi-drug resistance illustrated in this study Table (4,5) is of great concern for pregnant women due to the fact that these antibiotics have less effect on isolates which will create serious problem in health profession strategy and requirement to reduce rational use of antibiotics is of priority concern, for further extension of antibiotics life spam [33,34].

Isolated Bacteria	No Resistant to				Total MDR	% MDR
	No. of isolate	3 Drugs	4 Drugs	> 5 Drugs		
E.coli	97	41	19	5	65	67.0
S.aureus	53	26	9	4	39	73.6
Coliforms	51	15	9	3	27	53.0
K.pneumonia	41	16	4	1	21	51.2
S.epidermi	11	1	1	1	3	27.3
S.faecialis	6	2	1	1	4	66.6
Bacteriodes	4	1	1	0	2	50.0
P.mirabilis	3	1	1	0	2	66.6
P.aeuroginosa	4	1	1	1	3	75.0
Total	270	104 (38.%5)	46 (17.0%)	16 (5.9%)	165	61.1

Table 4: *Prevalence of MDR Bacteria Isolates in Urine Samples of Pregnant Women in Jordan.*

Isolated Bacteria	No Resistant to				Total MDR	% MDR
	No. of isolate	3 Drugs	4 Drugs	> 5 Drugs		
E.coli	33	8	7	5	20	60.6
S.aureus	74	28	11	8	47	63.5
Coliforms	9	3	2	0	5	55.6
S.epidermi	19	2	1	1	4	21.1
S.faecialis	8	3	1	1	5	62.5
P.aeuroginosa	6	2	1	1	4	66.6
Tatal	149	46 (30.8%)	23 (15.4%)	16 (10.7%)	85	57.1

Table 5: *Prevalence of MDR Bacteria Isolates in HVS Samples of Pregnant Women in Jordan.*

Drug resistant in this study will add further problem for pregnant women treatment as already mentioned that high percentage of infection in pregnant women is asymptomatic and these symptoms will change to symptomatic infections if they did not diagnose early leading to infant morbidity and mortality [35] therefore, the remarkable resistant of these isolates in this study is of great concern for laying out the base line for future treatments and to avoid invention of new MDR strains.

Isolate from urine and HVS samples showed high prevalence rate and high antibiotics resistance patterns although, some variation was noticed in their effective rate, such variation might be of concern for public health sector regarding urigenital infection and drug prescribing policy for pregnant women in particular and for prescribing antibiotics in general in countries where respected surveillance system occur.

Our recommendation is to carry out routine HVS and urine culture for all pregnant women to ensure good health for mother and fetus regardless sign of infections to provide back ground for further efficient control in antenatal care units and to provide better management policy. This will enhance reduction of the devastating effects of microbial infections in pregnancy and protecting and fetus health.

The overall antimicrobial activity pattern showed that meropenem was the most effective antibiotic rate of 100.0% for urine and HSV isolates followed by Iepipenim, levoloxacin, norfloxacin, cefoxitin and tobromicin showed high activity rate Table 2 and 3. The above result gives strong indication for using these antibiotics for infections however, urgent policy for efficient surveillance system, drugs prescribing, treatment strategy and management in public health and even in the private sector should be implemented.

Bibliography

1. Matuszkiewicz RJ., *et al*. "Urinary tract infections in pregnancy: old and neunresolved diagnostic and therapeutic problems". *Archives of Medical Science* 11.1 (2015): 67-77.
2. Gilstrap LC and Ramin SM. "Urinary tract infections during pregnancy". *Obstetrics and Gynecology Clinics of North America* 28.3 (2001): 581-591.
3. Akerele J., *et al*. "Prevalence of asymptomatic bacteriuria among pregnant women in Benin City Nigeria". *Journal of Obstetrics and Gynaecology* 21.2 (2001): 141-144.
4. Anyadoh-Nwadike SO., *et al*. "Comparative study of the prevalence and antibiogram of bacterial isolates from the urinary and genital tracts of antenatal patients". *IOSR Journal of Pharmacy and Biological Science* 10 (2015): 15-19.
5. Lee M., *et al*. "Urinary tract infections in pregnancy". *Canadian Family Physician* 54.6 (2008): 853-854.
6. Anyadoh SO., *et al*. "Prevalence of multidrug resistant *Escherichia coli* among pregnant women in Owerri". *International Journal of Medical Sciences and Technology* 3.3 (2010): 17-20.
7. Onuh SO., *et al*. "Microbiological isolates and sensitivity pattern of urinary tract infection in pregnancy in Benin City, Nigeria". *Ebonyi Medical Journal* 5.2 (2006): 48-52.
8. Zinner SH. "Management of urinary tract infection in pregnancy; A review with comments on single dose therapy". *Journal of Infection* 20 (1992): S280.
9. Akerele J., *et al*. "Prevalence of asymptomatic genital infection among pregnant women in Benin-city, Nigeria". *African Journal of Reproductive Health* 6.3 (2002): 93-97.
10. Lucas MJ and Cunningham FG. "Urinary tract infection complicating pregnancy". In Williams Obstetrics. 19th ed., McGraw Hill, New York pp. 1 -15.
11. Homeier BP. "Ten things that might surprise you about being pregnant". 2004.
12. Neu HC. "The crisis in antibiotic resistance". *Science* 257.5073 (1992): 1064 -1072.
13. Osuala FOU., *et al*. "Antibacterial activities of two local medicinal plants, Utazi (Gongronema latifolium) and Nchuanwu (Ocimum gratissimum)". *International Journal of Natural and Applied Sciences* 1.1 (2005): 36 -39.
14. Todar K. "Online Textbook of Bacteriology". 2009.
15. Momoh ARM., *et al*. "Resistance pattern of urinary tract infection bacterial isolates to selected quinolones". *Benin Journal of postgraduate Medicine* 9.1 (2007): 22-27.
16. Van Hoek AHAM., *et al*. "Acquired antibiotic resistance genes: an overview". *Frontiers in Microbiology* 2 (2011): 203.
17. Russel AD. "Types of antibiotics and synthetic antimicrobial agents". In Pharmaceutical Microbiology. Hugo, W.B and A.D. Russell (eds.) 5th ed. Blackwell Scientific Publications, London (1994) Pp.99-133.
18. Cheesbrough M. "District laboratory practice in tropical countries". Part 2. Cambridge University Press (2000).
19. Uneke CJ and Alo MN. "Nongonococcal and nonchlamydial microbial isolates from high vaginal swabs of Nigerian women diagnosed with pelvic inflammatory disease". *The Internet Journal of Infectious Diseases* 6 (2007): 1 -9.
20. Melvin DG. "Optimum therapy for acute pelvic inflammatory disease". *Drugs* 39.4 (1990): 511- 522.

21. Nworie A and Eze UA. "Prevalence and aetiologic agents of urinary tract infection in pregnancy in abakaliki metropolis". *Continental Journal of Medical Research* 4 (2010): 18 -23.
22. Imade PE and Eghafona NO. "Incidence of bacteriuria in antiretroviral-naïve HIV positive children less than five years of age in Benin City, Nigeria". *Libyan Journal of Medicine* 5 (2010): 90 -91.
23. Onyemelukwe NF., *et al*. "Significant bacteriuria in pregnancy in Enuhun, Nigeria". *Journal of College of Medicine* 8.2 (2003): 20-22.
24. Knobler SL. "The resistance phenomenon in microbes and infectious disease vectors". Implications for Human Health and Summary. National Academics Press, USA. p. 34.
25. Kaplowitz N. "Hepatology highlights". *Hepatology* 41.2 (2005): 227-228.
26. http://livertox.nih.gov/
27. Moulds R and Jeyasingham M. "Gentamicin: a great way to start". *Australian Prescriber* 33 (2010): 134-135.
28. Prescott ML., *et al*. "A Textbook of Microbiology". 6th edition. McGraw Hill, New York (2005).
29. Olukoya DK., *et al*. "Plasmid profiles and antibiotic resistance patterns of Staphylococcus aureus isolates from Nigeria". *African Medical Sciences* 24 (1995): 135-139.
30. Bukhari SZ., *et al*. "Antimicrobial susceptibility pattern of Staphylococcus aureus on clinical isolates and efficacy of laboratory tests to diagnose MRSA: A multi-centre study". *Journal of Ayub Medical College* 23.1 (2011): 139-142.
31. Narten M., *et al*. "Susceptibility of Pseudomonas aeruginosa urinary tract isolates and influence of urinary tract conditions on antibiotic tolerance". *Current Microbiology* 64.1 (2012): 7-16.
32. Onanuga A., *et al*. "Prevalence and susceptibility pattern of methicillin resistant Staphylococcus aureus isolates among healthy women in Zaria, Nigeria". *African Journal of Biotechnology* 4 (2005): 1321-1324.
33. Magiorakos AP., *et al*. "Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance". *Clinical Microbiology and Infection* 18.3 (2012): 268-281.
34. Nicolle LE., *et al*. "Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults". *Clinical Infectious Diseases* 40.5 (2005): 643-654.

Volume 2 Issue 2 September 2015