Microbial Isolates and Sensitivity Patterns among Antenatal Patients with Asymptomatic Bacteriuria in a Tertiary Hospital in North-Central Nigeria

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Abstract

Introduction: Asymptomatic bacteriuria (ASB) in pregnancy is defined as the presence of at least 10^5 colony-forming units per milliliter of a bacteria species in clean-catch urine in the absence of obvious symptoms of urinary tract infection during pregnancy. It is associated with obstetric complications such as preeclampsia, pyelonephritis, preterm labor, low birth weight, and prematurity. Determining the microbial isolates and sensitivity patterns of ASB among pregnant women locally will aid the management of ASB in pregnancy and prevention of complications associated with it. **Objective:** The aim of the study was to determine the microbial isolates and sensitivity pattern among antenatal patients with ASB at the Federal Medical Center (FMC), Keffi, Nasarawa state. **Materials and Methods:** This is a cross-sectional study among pregnant women attending the antenatal clinic at the FMC, Keffi, with ASB. Clients who met the selection criteria were recruited for the study. A structured pro forma was administered, and midstream urine samples were collected and processed. Result was analyzed using the Statistical Package for the Social Sciences version 20. Chi-square at a significant level of 0.05 and confidence level of 95% was used to determine significance. **Results:** A total of 184 consented women presenting for their first antenatal visit were screened for ASB, of which 82 were positive for significant bacteriuria, giving a prevalence of 44.6%. The ages of the participants ranged from 18 to 43 with a mean age of 29.58 ± 5.42 years. The common uropathogens isolated were *Staphylococcus aureus* 43 (52.4%), *Klebsiella spp.* 14 (17.1%), and *Escherichia coli* 13 (15.9%). The isolates were most sensitive to amoxicillin-clavulanate (85.4%), nitrofurantoin (82.9%), and gentamicin (79.3). **Conclusion:** The prevalence of ASB among the study participants was high. *S. aureus, Klebsiella spp.,* and *E. coli* were the predominant organisms cultured while most of the isolates were sensitive to amoxicillin-clavulanate, nitrofurantoin, and gentamicin.

Keywords: Asymptomatic bacteriuria, microbial isolates, midstream urine

Introduction

Asymptomatic bacteriuria (ASB) is defined as the presence of actively multiplying bacteria in the urinary tract, excluding the distal urethra, in a patient without any obvious symptom.[1-3] It is a strong predictor of subsequent symptomatic urinary tract infection (UTI). The presence of 10^5 or more colony-forming units per milliliter (CFU/ml) of bacteria in two consecutive clean-catch midstream urine has been taken as significant in making the diagnosis of ASB.[4]

UTIs are the most common bacterial infection in pregnancy.[5] They may present as ASB, acute cystitis, or pyelonephritis.[5] In general, it is a benign condition in most adults; however, ASB in pregnant women is associated with an increased risk of complications, especially upper UTIs (pyelonephritis) and preterm birth.

While pyelonephritis normally requires hospitalization and sometimes leads to severe complications such as sepsis and hematologic problems (anemia and thrombocytopenia),

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preterm birth is the main contributor to infant morbidity and mortality.[6,7] ASB can also be found in nonpregnant women, however, a number of physiologic changes in pregnancy predispose a woman to bacteriuria.[1,3,7]

The quantitative urine culture is considered to be the gold standard for accurate detection of ASB. However, it is costlier, more labor intensive, and more time-consuming compared with other rapid urine screening tests (urinalysis and dipstick nitrite test).[8]

A 2015 Cochrane review found that antibiotic treatment for ASB may greatly reduce the incidence of pyelonephritis, preterm birth, and low birth weight babies.[9]

Screening of all pregnant women for significant ASB and treatment will significantly reduce the incidence of overt UTIs in pregnancy.

Prevention of UTIs and pyelonephritis through screening and treatment of ASB in pregnancy will decrease maternal morbidity and save cost. This is so because treatment of pyelonephritis in pregnancy requires parenteral drugs and hospitalization which are more expensive than detection and treatment of symptomatic bacteriuria.

The purpose of this study is to determine the prevalence of ASB in pregnancy, pattern of microbial isolates, and antibacterial sensitivity among antenatal patients at the Federal Medical Center (FMC), Keffi, Nasarawa state.

Materials and Methods

Ethics

The ethical approval for the study was obtained from the Hospital Research and Ethical Committee of the FMC, Keffi. The participants gave written informed consent for the study, and ethical standards were adhered to in the collection, handling, and processing of samples during the study.

Study design

This was a prospective cross-sectional study carried out among consecutive pregnant women presenting to the antenatal clinic of the FMC, Keffi, for the first time at a specific day of the week chosen by simple random sampling every week from July 1, 2019, to February 28, 2020. A total of 184 consenting women were screened for ASB out of the 200 recruited clients. Seven specimens were reported as contaminants, and nine questionnaires were discarded because of poor incomplete filling of the forms.

An interviewer-administered structured questionnaire was used to obtain sociodemographic and obstetric data. Clients who had symptoms of UTIs, used antibiotics at least 2 weeks before presentation, had chronic illnesses such as diabetes, sickle cell disease, and human immunodeficiency virus, and those diagnosed with congenital anomaly of the urinary tract were excluded from the study.

Participants were given labeled sterile universal bottles after completion of the questionnaire and counseled on how to collect clean-catch midstream urine. The urine samples were transported to the laboratory in an ice-packed container for analysis. The urine samples were inoculated in a cysteine–lactose–electrolyte-deficient agar plate using a sterile calibrated wire loop that holds 1/500 ml (0.002 ml) of urine and incubated over 24 h at 37°C. A count of $\geq 10^5$ CFU/ml was used to defined significant bacteriuria. The significant growths were then identified using standard biochemical test.

Susceptibility testing was done using the modified Kirby–Bauer method. The zone of inhibition for each antibiotic for an isolate was measured in millimeter and compared to that specified by the Clinical and Laboratory Standards Institute chart to designate the isolates as either susceptible or resistant. This was used to complete the pro forma. The participants were then notified of their result and appropriate antibiotics provided according to the identified organism sensitivity.

Data management and analysis

Data collection was done using a pro forma containing relevant demographics and obstetric information and the laboratory results. This was subsequently inputted by two research assistants by dual entry and subsequently analyzed with the aid of a statistician, using the Statistical Package for social sciences version 20 by International Business Machines (IBM), New York, United States. Organisms isolated were analyzed in proportion of positive or negative samples, while the drug sensitivity profile was reported in proportions with the antibiogram used in its susceptibility testing.

Results

A total of 184 consenting pregnant women were screened for the presence of bacteria in their urine. The ages of the women ranged from 18 to 43 with a mean age of 29.58 ± 5.42 years. Most of the women screened were in the age group of 25–29 years (29.9%) while the age group of the women with the least is 15–19 years 8 (4.3%). The participant's social class using Olusanya's method showed that most of them are from the middle socioeconomic class constituting 116 (63.1%) and the least from the upper class 26 (14%). The largest proportion of the women who were screened booked at the second trimester of pregnancy 108 (58.7%) while the least presented at the third trimester 35 (19%) with a mean gestational age of 20.03 ± 7.62. While primigravida constitutes the largest percentage of the screened women (38.6%), the grand multiparous were the least at 6.5%. The summary of the sociodemographic profile of the respondents is represented in Table 1.

Of the 184 women screened for ASB, 82 were positive for ASB, giving a prevalence of 44.6% in the study population as depicted in Figure 1.

The distribution of bacteria isolates is shown in Figure 2. The dominant bacteria were *Staphylococcus aureus* 43 (52.4%) and *Klebsiella* 14 (17.1%). The other isolates were *Escherichia coli* 13 (15.9%), *Proteus spp.* 7 (8.5%), and *Pseudomonas spp.* 5 (6.1%).

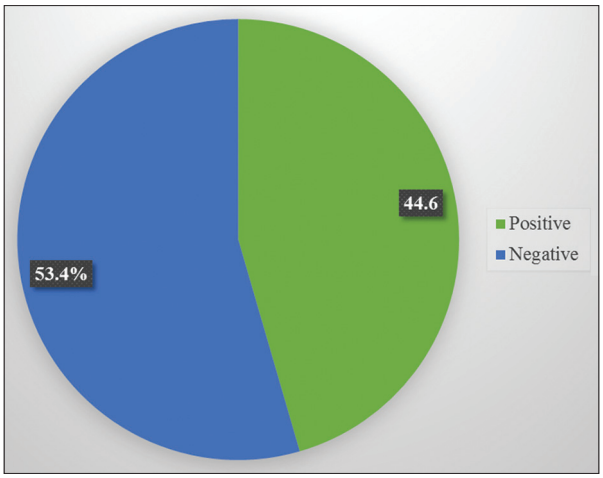

Figure 1: Pie chart showing prevalence of asymptomatic bacteriuria among booking patients in Federal Medical Center, Keffi

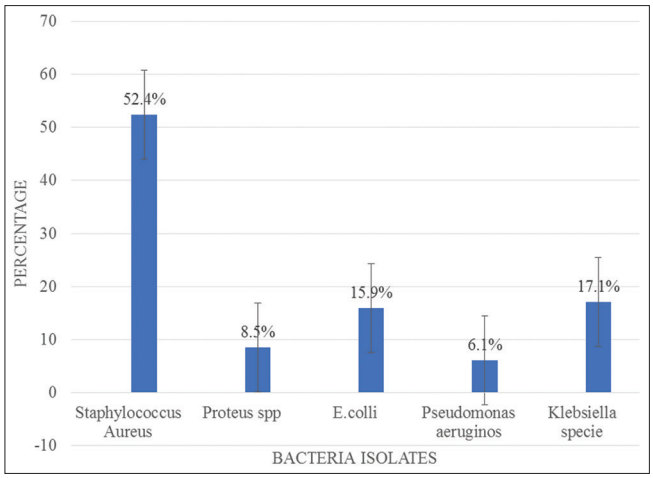

Figure 2: Distribution of bacteria isolated

Table 1: Sociodemographic and obstetric characteristics of respondents (*n*=184)

Characteristics	*n* (%)
Age (years)	
15-19	8 (4.3)
20-24	22 (12.0)
25-29	64 (34.8)
30-34	55 (29.9)
35 and above	35 (19.0)
Socioeconomic class	
Upper	26 (14.1)
Middle	116 (63.1)
Lower	42 (22.8)
Estimated gestational age	
First trimester	41 (22.3)
Second trimester	108 (58.7)
Third trimester	35 (19.0)
Parity	
0	71 (38.6)
1	33 (17.9)
2	38 (20.7)
3	13 (7.1)
4	17 (9.2)
5 and above	12 (6.5)

The isolated organisms were subjected to drug sensitivity test. A total of eight different antibiotics that can be used in pregnancy were used. Table 2 shows a composite table of the isolated bacteria and their sensitivity profile to the antibiotics exposed.

Amoxicillin-clavulanic acid showed an 85.4% sensitivity profile to the exposed organisms while next in sensitivity was nitrofurantoin with 82.9% sensitivity and was closely followed by gentamicin with 79.3% sensitivity, as illustrated by Table 2.

The most common isolated organism, *S. aureus*, was most sensitive to nitrofurantoin with a sensitivity of 88.4% to the drug and followed closed by amoxicillin-clavulanate and gentamicin at 83.7% each.

Of the drugs in the antibiogram used, the isolates were most resistant to sulfamethoxazole/trimethoprim, with a resistance of 62.2%. This was followed by erythromycin and amoxicillin at 62.2% and 56.1% resistance, respectively.

From the sociodemographics, it was found that age and estimated gestational age were statistically significant factors in the prevalence of ASB among the respondents with a *P* value of 0.006 and 0.034, respectively. The socioeconomic class and parity of the participants showed no significant difference in the occurrence of ASB. This is shown in Table 3.

Discussion

This study which was based on screening with urine culture, currently the gold standard for the detection of ASB, found a prevalence of ASB of 44.6% among antenatal patients presenting for their first antenatal visit. The high incidence of ASB among pregnant women in this study was similar to the findings of Urombo *et al*.[10] in Abuja and Ajayi *et al*.[11] in Ilorin (both in North-Central Nigeria) with a prevalence of 45.9% and 40%, respectively. This was though higher than 16.9% found in Sagamu,[12] 19.5% in Nnewi,[13] and 21.2% in Ethiopia.[14] However, quite low compared to findings by Akerele *et al*. in Benin that reported an incidence of 86.6%.[15] The differences observed may be linked to variation in the characteristic of the population under study such as age, parity, religion, and socioeconomic and bacterial patterns. In general, increasing age was associated with a higher prevalence of ASB in this study; this was also reported by Sescon *et al*.[16] This may be attributed to increased parity, increased sexual activity, and previous contraceptive use which are all predisposing factors.[2,11,17-19] This study also found a marked increase in prevalence of ASB in the second trimester constituting about 67% of the patients tested positive. However, similar studies by Akinloye *et al*.[20] found an increased association with parity which was not the case in this study.

Table 2: Isolates and antibacterial sensitivity patterns

Drugs	*Staphylococcus aureus* (43)	Organisms				Sensitivity (%)	Resistance (%)	Difference	*P*
		Escherichia coli (13)	*Pseudomonas aeruginosa* (5)	*Klebsiella* species (14)	*Proteus* spp. (7)				
SXT	2	2	4	5	4	20.7	79.3	−58.6	<0.001
NFT	38	9	3	12	6	82.9	17.1	65.8	<0.001
AML	14	8	2	5	7	43.9	56.1	−12.2	0.087
E	16	2	3	6	4	37.8	62.2	−24.4	<0.001
GN	36	8	5	11	5	79.3	20.7	58.6	<0.001
AMC	36	9	5	13	7	85.4	14.6	70.8	<0.001
CXM	17	9	0	12	2	48.8	51.2	−2.4	0.874
CRO	16	9	0	11	3	47.6	52.4	−4.8	0.622

SXT: Sulfamethoxazole/trimethoprim, NFT: Nitrofurantoin, AML: Amoxicillin, E: Erythromycin, GN: Gentamicin, AMC: Amoxicillin-clavulanic acid, CXM: Cefuroxime, CRO: Ceftriaxone

Table 3: Relationship between sociodemographic factors and presence of asymptomatic bacteria among the respondents

Factors	Asymptomatic bacteria		Total (*n*=184), *n* (%)	χ^2	*P*
	Positive (*n*=82), *n* (%)	Negative (*n*=102), *n* (%)			
Age (years)					
15-19	5 (6.1)	3 (2.9)	8 (4.3)	13.943**	0.006
20-24	11 (13.4)	11 (10.8)	22 (12.0)		
25-29	25 (30.5)	39 (38.2)	64 (34.8)		
30-34	17 (20.7)	38 (37.3)	55 (29.9)		
35 and above	24 (29.3)	11 (10.8)	35 (19.0)		
Socioeconomic class					
Upper	14 (17.1)	12 (11.8)	26 (14.1)	1.767	0.413
Middle	47 (57.3)	69 (67.6)	116 (63.1)		
Lower	21 (25.6)	21 (20.6)	42 (22.8)		
Estimated gestational age					
First trimester	18 (22.0)	23 (22.5)	41 (22.3)	6.767	0.034
Second trimester	55 (67.1)	53 (52.0)	108 (58.7)		
Third trimester	9 (10.9)	26 (25.5)	35 (19.0)		
Parity					
0	31 (37.8)	40 (39.2)	71 (38.6)	6.257	0.282
1	15 (18.3)	18 (17.6)	33 (17.9)		
2	17 (20.7)	21 (20.7)	38 (20.7)		
3	5 (6.1)	8 (7.8)	13 (7.1)		
4	5 (6.1)	12 (11.8)	17 (9.2)		
5 and above	9 (11.0)	3 (2.9)	12 (6.5)		

**Fisher's exact test

In this study, the prevalence of ASB was highest among women that booked in the second trimester; this is similar to other studies that have found increased prevalence in the second and third trimesters.[2,11,18,19] This may be ascribed to the increasing mechanical effect of the growing fetus and hormonal changes including the effect of progesterone that results in smooth muscle relaxation and stasis encouraging colonization and ascension of uropathogens along the urinary tract.

In this study, *S,aureus, E.coli*, and *klebsiella spp*. were the predominant organisms isolated. Others include *Proteus spp.* and *Pseudomonas aeruginosa*. *S. aureus* was found as the most common offending organism, constituting 52.4% of the organism isolated in this study. This is similar to the findings Ajayi *et al*. in lorin,[11] Urombo *et al*. in Abuja,[10] Turpin *et al*. in Kumasi,[19] Oli *et al*. in Nnewi,[21] and Pam *et al.* in Zaria[22] However, *E. coli* was the predominant organism isolated in many other studies.[1-3,21,23] The predominance of *S. aureus* may be attributed to the bacterial ecology of the region as a good number of the studies done in Nigeria having *S. aureus* dominance were done in North-Central Nigeria.

From this study, most of the isolated uropathogens demonstrated high sensitivity to amoxicillin-clavulanate, nitrofurantoin, and gentamicin. This is similar to findings by Ezeome *et al*.[24] in Enugu and Ajayi *et al*. in Ilorin.[15] Sulfamethoxazole/trimethoprim demonstrated significant activity only against *Pseudomonas spp.* (80%) while very poor to the most cultured pathogen, *S. aureus*. The trio of amoxicillin-clavulanate, nitrofurantoin, and gentamicin demonstrated at least

60% sensitivity to all the organisms isolated with amoxicillin-clavulanate showing almost 100% activity against four of the isolates and near 70% to the fifth (*E. coli*).

The isolated organisms showed high resistance to commonly used antibiotics such as sulfamethoxazole/trimethoprim, amoxicillin, and erythromycin. This was similarly observed by Olamijulo *et al*. in Lagos[25] and Urombo *et al*. in Abuja.[10] These antimicrobials are commonly used in management of UTIs in pregnancy. This pattern of antibacterial sensitivity and resistance has been noted in previous studies with injudicious use and abuse of antibiotics a most probable cause.

This study has demonstrated that amoxicillin-clavulanate, nitrofurantoin, and gentamicin are very effective against most of the uropathogens isolated. However, while amoxicillin-clavulanate and nitrofurantoin are designated Food and Drug Administration Class B drugs, gentamicin is Class D. Nitrofurantoin is relatively safe in pregnancy and is effective against most UTIs but may cause hemolysis in G6PD-deficient infants if used closed to term,[26] therefore, it should be avoided in the last 4 weeks of pregnancy. Gentamicin, an aminoglycoside, has been associated with ototoxicity, nephrotoxicity, nephrotoxicity, and eighth cranial nerve damage among babies with *in utero* exposure. Hence, should be used with caution in pregnancy.[26]

Conclusion

In general, the prevalence of ASB of 44.6% in this study is high. Predominant organisms isolated include *S. aureus*, 52%, *Klebsiella* spp., 17.1%, and *E. coli,* 15.9%, with amoxicillin-clavulanate, nitrofurantoin, and gentamicin as the most effective antimicrobials. ASB is an important risk factor for the development of symptomatic UTIs during pregnancy with potential for adverse maternal and fetal health. Therefore, screening during the first trimester or first antenatal visit and subsequent treatment will prevent the adverse effect associated with it and enhance maternal care.

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Conflicts of interest

There are no conflicts of interest.

References

1. Fox NS, Rebarber A. Renal and Urinary tract disorders in pregnancy. In. Decherney AH, Nathan N, Laufer N, Roman AS, editors. Current Diagnosis and Treatment, Obstetrics and Gynaecology. 11th ed., Vol. 28. New York: The McGraw-Hill Companies; 2013. p. 483-92.
2. Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, *et al*. Renal and urinary tract disorders. In: Williams Obstetrics. 24th ed., McGraw-Hill Education, New York.2014;53:1962-98.
3. Hooton TM, Gupta K. Urinary Tract Infections and Asymptomatic Bacteriuria in Pregnancy. Wolter Kluwer, Netherlands UpToDate. ver 19.8, 2017.
4. Kirby A, Simpson N, Gray J. Testing for asymptomatic bacteriuria in pregnancy. Eur J Obstet Gynecol Reprod Biol 2016;205:192-4.
5. Kallinderi K, Delkos D, Kallinderis M, Athanasiadis A, Kalogiannidis. Urinary tracy infections during Pregnancy: Current concepts on a multifaceted problem. J Obstet Gynaecol 2018;38:448-453.
6. Angelescu K, Nussbaumer-Streit B, Sieben W, Scheibler F, Gartlehner G. Benefits and harms of screening for and treatment of asymptomatic bacteriuria in pregnancy: A systematic review. BMC Pregnancy Childbirth 2016;16:336.
7. Lentz G. Urinary tract infections in obstetrics and gynaecology. Glob Libr Women's Med. (ISSN:1756-2228) 2009; DOI: 10.3843/GLOWM.10118.
8. Glaser AP, Schaeffer AJ. Urinary tract infection and bacteriuria in pregnancy. Urol Clin North Am 2015;42:547-60.
9. Smaill FM, Vazquez JC. Antibiotics for asymptomatic bacteriuria in pregnancy. Cochrane Database Syst Rev 2015;8:CD000490.
10. Urombo CT, Agboghoroma CO, Efetie ER. Asymptomatic Bacteriuria in Pregnant women attending antenatal clinic in a tertiary hospital in Abuja. Trop J Obstet Gynaecol 2015;32:27-33.
11. Ajayi AB, Nwabuisi C, Aboyeji AP, Ajayi NS, Fowotade A, Fakeye OO. Asymptomatic bacteriuria in antenatal patients in Ilorin, Nigeria. Oman Med J 2012;27:31-5.
12. Sule-Odu AO, Oluwole AA, Akadiri AA, Adeiyi TO, Sotunsa JO, Durojaiye BO. Asymptomatic urinary tract infection among pregnant women in Sagamu, Nigeria. Afr J online 2014;66:1-2.
13. Igwegbe AO, Ugboaja JO, Okoli OA. Prevalence of asymptomatic bacteriuria among pregnant women in Nnewi, Southeast Nigeria. Int J Biol Chem Sci 2012;6:88-98.
14. Tadesse E, Teshome M, Merid Y, Kibret B, Shimelis T. Asymptomatic urinary tract infection among pregnant women attending the antenatal clinic of Hawassa Referral Hospital, Southern Ethiopia. BMC Res Notes 2014;7:155.
15. Akerele J, Abhulimen P, Okonofua F. Prevalence of asymptomatic bacteriuria among pregnant women in Benin City, Nigeria. Afr J Reprod Health 2002;6:93-7.
16. Sescon NI, Garingalo-Molina FD, Yeasiano CJ. Prevalence of asymptomatic bacteriuria and associated risk factors in pregnant women. Phil J Microgial Infect Dis 2003;32:63-9.
17. Johnson EK. Urinary Tract Infections in Pregnancy; 2017. Available from: https://emedicine.medscape.com. [Last accessed on 2020 Oct 10].
18. Abdel-Aziz Elzayat M, Barnett-Vanes A, Dabour MF, Cheng F. Prevalence of undiagnosed asymptomatic bacteriuria and associated risk factors during pregnancy: A cross-sectional study at two tertiary centres in Cairo, Egypt. BMJ Open 2017;7:e013198.
19. Turpin C, Minkah B, Danso K, Frimpong E. Asymptomatic bacteriuria in pregnant women attending antenatal clinic at Komfo Anokye Teaching Hospital, Kumasi, Ghana. Ghana Med J 2007;41:26-9.
20. Akinloye O, Ogbolu OD, Akinloye OM, Terry-Alli OA. Asymptomatic bacteriuria of pregnancy in Ibadan, Nigeria: A re-assessment. BR J Biomed Sci 2006;63:109-12.
21. Oli AN, Okafor CI, Ibezim EC, Akujiobi CN, Onwunzo MC. The prevalence and bacteriology of asymptomatic bacteriuria among antenatal patients in Nnamdi Azikiwe University Teaching Hospital Nnewi; South Eastern Nigeria. Niger J Clin Pract 2010;13:409-12.
22. Pam S, Shittu SO, Olayinka AT, Adaji SE, Ejembi J. Pattern of microbial isolates and microbial sensitivity among HIV positive pregnant women with Asymptomatic Bacteriuria in Zaria, Nigeria. Int J Med Bio Res 2015;4:55-62.
23. Ayoyi AO, Kikuvi G, Bii C, Kariuki S. Prevalence, aetiology and antibiotic sensitivity profile of asymptomatic bacteriuria isolates from pregnant women in selected antenatal clinic from Nairobi, Kenya. Pan Afr Med J 2017;26:41.
24. Ezeome IV, Ikeme AC, Okezie OA, Onyebueke EA. Asymptomatic bacteriuria (ASB) in pregnant women in Enugu, Nigeria. Trop J Obstet Gynecol 2006;23:12-3.
25. Olamijulo JA, Adewale CO, Olaleye O. Asymptomatic bacteriuria among antenatal women in Lagos. J Obstet Gynaecol 2016;36:722-5.
26. Katzung BG. Basic and Clinical Pharmacology. In: Miscellaneous Antimoicrobial Agents; Disinfectants, Antiseptics and Sterilants. 14th ed. Vol. 50. New York: McGraw-Hill Education; 2018. p. 1125-31.