**In-vitro** Antibiotic Susceptibility Tests of Bacterial Isolates from Abdominal Wound Infection in a Nigerian Teaching Hospital

Adeyinka Ayodele Adejumo¹*, Sunday Kelvin Obiano² and Kenneth Ikenna Onyedibe³

¹Department of Surgery, Federal Medical Centre, Keffi, Nassarawa State, Nigeria.
²Department of Surgery, Federal Teaching Hospital, Gombe, Gombe State, Nigeria.
³Department of Medical Microbiology, Jos University Teaching Hospital, Jos, Plateau State, Nigeria.

**Authors’ contributions**

This work was carried out in collaboration between all authors. Author AAA was involved in the conception, design and literature search. He also contributed significantly to the writing of the discussion section. Author SKO was involved in the study design and literature search. Author KIO was involved in statistical analysis, study design and protocol and literature review. All the authors have read and approved the final manuscript.

**Article Information**

DOI: 10.9734/BJMMR/2016/23202

**ABSTRACT**

**Aims:** The trend of increasing antibiotic resistance has been reported from various centres. The aim of this study was to look at the pattern of resistance of bacterial isolates from abdominal wound infections and determine its magnitude in a bid to establish appropriate antibiotic stewardship program in the centre.

**Study Design:** A prospective cross sectional study that looked at pattern of antibiotic susceptibilities in isolated organisms from infected laparotomy wounds.

*Corresponding author: E-mail: dradejumoaa@gmail.com;*
Place and Duration of Study: Department of Surgery (General Surgery Unit) and Department of Medical microbiology, Federal Teaching Hospital, Gombe; between January 2012 and December 2012.

Methods: All adult patients (eighteen years and above) who had either emergency or elective laparotomy for one indication or the other were recruited into this study. Wound inspection was done on days 3, 5, 7; swabs were taken in infected cases under aseptic condition and processed according to microbiological standards.

Results: Eighty five (38.1%) patients developed wound infection out of the 223 that met the inclusion criteria. This consists of 157 (70.4%) males and 66 (29.6%) females. Their ages ranged between 18 and 80 years. Males developed wound infection more than females. Dirty wounds had the highest infection rate. The most common isolates were *Klebsiella spp* (34%), *Staphylococcus aureus* (30.4%) and *Proteus spp* (19.6%). Multidrug resistance (>50%) to commonly used antibiotics such as amoxicillin-clavulanate, cotrimoxazole and gentamicin were seen in many isolates.

Conclusion: The emergence of multidrug resistant organisms calls for collaborative efforts and judicious use of antimicrobial agents among clinicians.

Keywords: Wound infection; microorganisms; multi-drug resistance.

1. INTRODUCTION

Surgical site infection (SSI) as recently defined by the Centres for Disease Control and Prevention (CDC) is one occurring after surgery in the part of the body where the surgery took place [1]. The extent of this might range from involvement of layers of the anterior abdominal wall (incision site) to involvement of the deep space/peritoneal cavity or specific organs within the abdominal cavity (organ/space) [1]. Surgical wounds are generally classified based on their degree on microbial contamination into clean, clean contaminated, contaminated and dirty wounds [2]. The susceptibility of a wound to infection is therefore directly related to each class of the wound. For clean wounds, gram positive organisms from the skin flora are usually the cause of infection while in other classes of wounds, polymicrobial aerobic and anaerobic organisms closely resembling the normal endogenous microflora of the affected organ are the usual isolates [3-5].

Some of these organisms have developed resistance to the commonly used antimicrobial agents over time. This is as a result of injudicious use of such drugs on the part of the patients and indiscriminate prescription on the part of clinicians [6,7]. This prospective study therefore aimed to look at the pattern of antibiotic resistance by organisms isolated from abdominal wound infection following laparotomies in a Nigerian teaching hospital.

2. METHODS

2.1 Study Centre and Design

This is a prospective cross sectional study carried out at the Federal Teaching Hospital, a tertiary health care centre which also serves as a referral centre located in Gombe, North-Eastern Nigeria from January 2012 to December 2012.

2.2 Recruitment of Study Participants and Sample Collection

The inclusion criteria were all adult patients (eighteen years and above) who had either emergency or elective laparotomy in the General Surgery unit at Federal Medical Centre, Gombe, North eastern, Nigeria and who subsequently developed surgical site infection within thirty days of surgery. [Eighteen years was the cut-off age for pediatric patients in the study centre as at the time of this study]. Informed consent was obtained from all patients recruited into the study and relevant clinical information entered into a proforma designed for the study. Ethical approval was obtained from the Institutional Ethics Review Board.

Patients’ wounds were inspected on post-operative days 3, 5 and 7 for local evidence of wound infection. The diagnostic criteria for clinically infected wound were based on the definition provided by the Centres for Disease Control and Prevention (CDC) and the National Healthcare Safety Network (NHSN) [2].
Wound swabs were collected from patients who had suspected or clinically infected wounds. This was done under aseptic procedure, cleansing the wound site with sterile gauze soaked in normal saline; parting the wound edges and dipping the sterile cotton-tipped specimen collection stick to the base of the wound and firmly rotating it while avoiding contact with the wound edges. The specimen were capped and labeled appropriately and thereafter sent to the Medical Microbiology laboratory. Microscopy of the specimen was done using gram staining technique. Each smear was examined at high magnification using an oil immersion (x100) objective lens. Gram positive organisms appeared blue/purple, while Gram negative organisms appeared pinkish red [8].

2.3 Culture

The samples collected were inoculated on blood agar, chocolate agar (Oxoid, Basingstoke, UK) and MacConkey agar (Fluka medica) plates using a sterile platinum wire loop. MacConkey and blood agar plates were incubated aerobically at a temperature of 35-37°C for 18-24 hours, while chocolate agar plates were incubated in a candle jar to facilitate the growth of fastidious organisms. Growth on the culture plates were examined macroscopically for colonial morphology. The colonies were subjected to appropriate biochemical tests for identification and classification [9].

2.4 Biochemical Confirmation

Biochemical test such as carbohydrate fermentation, oxidase production, catalase utilization, coagulase production, indole production, citrate utilization and ability to produce urease were employed in addition to microscopic findings to identify the organisms [10]. *Klebsiella spp* was identified as gram negative bacilli, non-motile, lactose fermenting, indole negative with a positive citrate utilization reaction. *Staphylococcus aureus* was identified as gram positive cocci with positive catalase and coagulase reactions. *Escherichia coli* was identified as gram negative bacilli, motile, lactose fermenting, positive indole and negative citrate reaction. *Proteus spp* were identified as gram negative bacilli, non-lactose fermenting with positive urease and negative oxidase reactions, swarming and motile.

2.5 Antibiotics Susceptibility Testing

Antibiotic susceptibilities were determined on Mueller-Hinton agar (Oxoid, Basingstoke, UK) by standard disk diffusion procedures. The inoculum in each peptone water broth was standardized by McFarland’s standard. The antibiotic discs were applied on two different 90 mm petri dishes, allowed to pre-diffuse for about 20 minutes and incubated at 37°C overnight: penicillin (10 units), ciprofloxacin (10 µg), gentamycin (10 µg), ceftazidime (30 µg), ceftriaxone (30 µg), cefuroxime (30 µg), sparfloxacin (30 µg), amoxicillin-clavulanic acid (30 µg). The control strains were run simultaneously with the test organisms. Positive antibiotic response was interpreted by the presence of zone of inhibition around the test organism based on Clinical Laboratory Standards Institute (CLSI) criteria [11].

3. RESULTS

Two hundred and twenty three patients met the inclusion criteria. This consists of 157 (70.4%) males and 66 (29.6%) females. Their ages ranged between 18 and 80 years. Eighty five (38.1%) patients had wound infection; 59 (69.4%) were males while 26 (30.6%) were females (M:F=2.3:1). Twenty two patients had clean wounds out of which three (13.6%) patients had SSI; 44 patients had clean contaminated wounds out of which 12 (27.3%) patients had SSI; 104 patients had contaminated wounds out of which 37 (35.6%) patients had SSI while 53 patients had dirty wounds out of which 41 (77.4%) patients had SSI. Patients with dirty wound had the highest infection rate while those with clean wound had the lowest (Fig. 1). Single bacterial isolate was seen in 56 (65.9%) patients and the organisms comprised *Klebsiella spp* (34%), *Staphylococcus aureus* (30.4%), *Proteus spp* (19.6%), *Providencia* (12.5%) and *Escherichia coli* (3.6%), while mixed infection was seen in 21 (24.7%) patients. The responses of the isolated organisms as single and mixed isolates to the various tested antibiotics are shown in Tables 1 and 2 respectively.

4. DISCUSSION

The pattern of isolated microorganisms from the surgical wounds in this study is similar to the profile that has been observed from other related studies within and outside Nigeria [12-16]. The resistance pattern demonstrated to the tested antibiotics could be seen to vary and a similar scenario has been widely reported [17-19]. The development of this resistance pattern could be attributed to injudicious use of antimicrobial agents which is common place in most third world countries as there are no rule prescription of antibiotics.
In Nigeria for example, it is a free for all as there has not been any regulations that govern who prescribes what. Antibiotics abound everywhere as over the counter drugs and clinicians most times do not wait before they start antibiotics as an empirical treatment. If they had to wait for culture result, patient may have sepsis. This is same for whole world especially after malignancy operations and complications. This is the common cause of antibiotic resistance [20,21]. The continuous exposure of microbial agents to these drugs over time eventually lead to reduced efficacy borne out of genetic modification of the target receptors on the microorganisms. Some of these organisms which are ubiquitous within the hospital environment have developed resistance to the commonly used antibiotics needed to suppress their proliferation.

The resistance to the commonly used antibiotics occurs through various plasmid-mediated mechanisms. These mechanisms include: decreased intracellular concentration of antibiotics (either increased efflux or reduced influx of the drug); neutralization by inactivating enzymes (β-lactamase); alteration of the target receptor on which the drug is to act and complete elimination of the target on which the drug is to act [22,23].

Bacterial isolates in this study were both monomicrobial and polymicrobial. Monomicrobial isolates were predominant and comprised largely (67%) of gram negative, aerobic organisms while Staphylococcus aureus was the only gram positive pathogen isolated. The gram negative organisms were largely from the intestinal flora as these were seen more in clean contaminated, contaminated and dirty wounds.

Klebsiella spp demonstrated a very good response to the cephalosporins, gentamicin and quinolones. However, there was a poor response to the use of penicillin and amoxicillin/clavulanic acid. The findings from Benue, North central, Nigeria [24] is comparable to ours but at variance with reports from Lagos [25] and Abuja [26] where these organisms showed a high pattern of resistance (>60%) to cephalosporins and gentamicin. Other workers from Ethiopia [27] and India [28] had reported similar resistance profile by Klebsiella spp. This resistance pattern may be due to the increasing development of extended spectrum beta lactamases (ESBLs) in the Klebsiella spp.

Staphylococcus aureus showed a good response to the use of amoxicillin/clavulanic acid, cephalosporins and quinolones. Jido et al. [29] working from Kano, North west, Nigeria had earlier reported a similar profile. Our observations tend to be in agreement with a study from Nepal [30] but inconsistent with that of another Nigerian study from Niger State where a high resistant profile was observed [31]. Although, in an Indian study by Sonawane et al. [28] Staphylococci showed complete (100%) susceptibility to vancomycin. The emergence of methicillin-resistant Staphylococcus aureus (MRSA) and other multidrug resistant patterns in some Nigerian centres is a pointer to the magnitude of the problem in our environment [32,33].
### Table 1. Profile of antibiotic susceptibility of the monomicrobial organisms isolated from the patients with wound infection

| Test antibiotics | *Klebsiella spp* | *Staphylococcus aureus* | *Proteus spp* | *Providencia spp* | *E. coli* |
|------------------|------------------|------------------------|---------------|-------------------|-----------|
|                  | T [S] (%)       | R [%]                | T [S] %s     | R [%]            | T [S] %s  |
| Gentamicin       | 19 [19] (100.0) | 0 (0.0)              | 17 [2] (11.8)| 15 [88.2] (100.0)| 7 [1] (100.0)|
| Ceftriaxone      | 19 [19] (100.0) | 0 (0.0)              | 17 [15] (88.2)| 2 [11.8] (0.0)  | 7 [1] (100.0)|
| Amoxicillin/clavulenate | 19 [5] (26.3) | 14 (73.7)            | 17 [17] (100.0)| 0 (0.0)       | 7 [3] (42.9)|
| Penicillin       | 19 [2] (10.5)   | 17 (89.5)            | 17 [14] (82.4)| 3 (17.6) (0.0)  | 7 [3] (42.9)|
| Cefuroxime       | 19 [16] (84.2)  | 3 (15.8)             | 17 [17] (100.0)| 0 (0.0)       | 7 [7] (100.0)|
| Ciprofloxacin    | 19 [15] (78.9)  | 4 (21.1)             | 17 [16] (94.1)| 1 (5.9) (0.0)  | 7 [4] (57.1)|
| Cefotaxime       | 19 [14] (73.7)  | 5 (26.3)             | 17 [17] (100.0)| 0 (0.0)       | 7 [7] (100.0)|
| Cotrimoxazole    | 19 [15] (78.9)  | 4 (21.1)             | 17 [14] (82.4)| 3 (17.6) (0.0)  | 7 [3] (42.9)|
| Ampicillin       | 19 [7] (36.8)   | 12 (63.2)            | 17 [11] (64.7)| 6 (35.3) (0.0)  | 7 [2] (28.6)|

Key: T - Number of tested isolates, S - number of tested isolates sensitive to the antibiotic used, %s - Percentage of tested isolate sensitive to antibiotic used, R - Number of resistant isolates, %R - Percentage of resistant isolates to tested antibiotic

### Table 2. Profile of antibiotic susceptibility of polymicrobial organisms isolated from the patients with wound infection

| Antibiotics            | T | S | %s | R | %R |
|------------------------|---|---|----|---|----|
| Ciprofloxacin          | 21| 17| 81.0| 4 | 19.0|
| Sparfloxacin           | 21| 14| 66.7| 7 | 33.3|
| Ceftriaxone            | 21| 21| 100.0| 0 | 0.0|
| Cefuroxime             | 21| 21| 100.0| 0 | 0.0|
| Ceftazidime            | 21| 19| 90.0| 2 | 10.0|
| Amoxicillin/ clavulanate | 21| 11| 52.4| 10| 47.6|
| Gentamicin             | 21| 21| 100.0| 0 | 0.0|
| Cotrimoxazole          | 21| 3 | 14.3| 18| 85.7|
| Penicillin             | 21| 2 | 9.5 | 19| 90.5|
| Ampicillin             | 21| 17| 33.3| 15| 66.7|

Key: T - Number of tested isolates, S - Number of tested isolates sensitive to the antibiotic used, %s - Percentage of tested isolate sensitive to antibiotic used, R - Number of resistant isolates, %R - Percentage of resistant isolates to tested antibiotic
Proteus spp demonstrated a good response of > 80% to the cephalosporins, quinolones and gentamicin. A resistance pattern of >63% was observed with the use of penicillin and cotrimoxazole. Our finding is consistent with that of Iregbu et al. [26] in Abuja, Nigeria and that of Mama et al. [27] in Ethiopia. Providencia also demonstrated a good response similar to that of Proteus spp. Escherichia coli had a sensitivity rate of > 95% to cephalosporins, quinolones and gentamicin but not penicillin and amoxicillin/clavulanic acid. Reports by workers from Uyo, South south Nigeria [34] revealed a resistant profile of 100% to ceftriaxone, gentamicin and quinolone and this is similar to what Sonawane and his colleagues [27] had earlier reported.

The poor responses of these organisms to the tested antibiotics were borne out of factors that have been identified to be peculiar to our environment. These include injudicious use of such drugs, poor patient compliance, sub-standard drugs and self medication [35-37]. The emergence of multi-drug resistant organisms is a nightmare for clinicians and the patients and the management of such may entail the use of newer generation but expensive antibiotics like meropenem and vancomycin as already reported from different climes [26,28,34]. Other newer agents that have been found useful in resistant cases include the glycopeptides (Dalbavacin, Oritavacin) and quinupristin/dalfopristin combination which have been found particularly useful in cases of vancomycin resistant organisms as well as methicillin resistant staphylococcus aureus (MRSA). Considering the peculiar problem of poverty in our environment, many of our patients might not be able to eventually afford the more potent, newer generation drugs when the need arises as is the case when dealing with multidrug resistant organisms. A change in policy direction and enforcing antibiotic stewardship might be a necessary way of combating this problem.

5. CONCLUSION

It is evident that there is an emerging problem of multidrug resistant organisms. Collaborative efforts are required among clinicians in order to curtail this trend. Well-structured antibiotic stewardship programmes in our institutions will be of judicious benefit. Government policies should strengthen and restrict the prescription of antibiotics in our hospitals to clinicians at appropriate levels while measures to curb the over the counter sale of antibiotics are put in place.

ACKNOWLEDGEMENT

Special thanks go to Dr I.A Esin and Dr P.F Adejoh for their supportive role during the course of this research work. The assistance of Mr Kudi Ayuba will not go unappreciated as well.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Horan TC, Andrus MA, Dudeck MA. CDC / NHSN Surveillance definition of healthcare associated infection and criteria for specific types of infection in the acute care setting. Am J Infect Control. 2008;36:309-332. DOI: 10.1016/j.ajic.2008.03.002
2. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, a modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol. 1992;13(10):606-608.
3. Rao R, Sumathi S, Anuradha K, Venkatesh D, Krishna S. Bacteriology of postoperative wound infections. Int J Pharm Biomed Res. 2013;4(2):72-76.
4. Amatya J, Rijal M, Baidya. Bacteriological study of the postoperative wound sample and antibiotic susceptibility pattern of the isolates in B & B Hospital. JSM Microbiology. 2015;3(1):1019.
5. Yamamoto T, Nishiyama A, Takano T. Community-acquired methicillin-resistant Staphylococcus aureus: Community transmission, pathogenesis and drug resistance. J Infect Chemother. 2010;16:225-254.
6. Jimoh AO, Etuk EU, Sani Z, Shuaib HA. The pattern of antibiotic use in a family medicine department of a Tertiary Hospital in Sokoto, North Western Nigeria. J Clin Diagn Res. 2011;5(3):566-569.
7. Elsididi HAA. Irrational use of antibiotics among people residing in Almamoura. Sudanese Journal of Public Health. 2010;5(1):50-55.
8. Brooks GF, Butel JS, Morse SA. Principles of diagnostic medical microbiology. In: Jawetz, Melnick and Adelberg's Medical
9. Koneman ER. Bacterial identification and antimicrobial susceptibility testing. In: Koneman's colour atlas and textbook of diagnostic microbiology. Washington CW, Elmer WK, Koneman ER, Stephen DA, William M. (Eds) 6th ed. Baltimore: Lippincott Williams and Wikins. 2006; 945-1063.

10. Jorgensen JH, Ferrano MJ, Turnidge JD. Susceptibility tests methods: Dilution and disk diffusion methods. Murray PR, Baron EJ, Jorgensen JH, Pfaller MA, Yolken RH (Eds).Manual of Clinical Microbiology 8th ed. Washington DC: American Society for Microbiology Press. 2003;1108-1127.

11. National Committee for Clinical Laboratory Standards. Performance Standard for Antimicrobial Susceptibility Testing. M100-159. 20.

12. Atata RF, Ibrahim YKE, Giwa A, Akanbi II A. Antibiotic resistance profile of bacterial isolates from surgical site and hospital environment in a University Teaching Hospital in Nigeria. J. Med. Med. Sci. 2013;4(4):181-187.

13. Akinkunmi EO, Adesunkanmi AR, Lamikanra A. Pattern of pathogens from surgical wound infections in a Nigerian hospital and their antimicrobial susceptibility profiles. Afr Health Sci. 2014;14(4):181-187.

14. Pondei K, Fente BO, Oladapo O. Current microbial isolates from wound swabs, their culture and sensitivity pattern at the Niger Delta University Teaching Hospital, Okolobiri, Nigeria. Trop Med Health. 2013;41(2):49-53.

15. Seni J, Najuka CF, Kateete DP, Makobore P, Joloba ML, Kajumbula H, et al. Antimicrobial resistance in hospitalized surgical patients; a silently emerging public health concern in Uganda. BMC Research Notes. 2013;6:298.

16. Dinda V, Gunturu R, Kariuki S, Hakeem A, Raja A, Kimanga A. Pattern of pathogens and their sensitivity isolated from surgical site infections at the Aga Khan University Hospital, Nairobi, Kenya. Ethiop J Health Sci. 2013;23(2):141-149.

17. Shittu AO, Okon K, Adesida S, Oyedara O, Witte W, Strommenger B, et al. Antibiotic resistance and molecular epidemiology of Staphylococcus aureus in Nigeria. BMC Microbiology. 2011;11:92.

18. Nwankwo EOK, Sale A, Magagi A, Ihesiolor G. Methicillin-resistant Staphylococcus aureus (MRSA) and their antibiotic sensitivity pattern in Kano, Nigeria. Afr. J. Clin. Exper Microbiol. 2010;11(10):129-136.

19. Godebo G, Kibru G, Tassew H. Multidrug-resistant bacteria isolates in infected wounds at Jimma University Specialized Hospital, Ethiopia. Ann Clin Microbiol Antimicrob. 2013;12:17.

20. Isik A, Okan I, Firtat D, Yilmaz B, Akccakaya A, Sahin M, et al. A new prognostic strategy for gastric carcinoma: Albumin level and metastatic lymphnode ratio. Minerv Chir. 2014;69(3):147-153.

21. Isik A, Peker K, Firtat D, Yilmaz B, Sayar I, Idiz O, et al. Importance of metastatic lymphnode ratio in non-metastatic, lymphnode-invaded colon cancer: A clinical trial. Med Sci Monit. 2014;20:1369-1375.

22. Blair JMA, Webber MA, Baylay AJ, Ogbovu DO, Piddock LJV. Molecular mechanisms of antibiotic resistance. Nat Rev Microbiol. 2015;13:42-51.

23. Cox G, Wright GD. Intrinsic antibiotic resistance: Mechanisms, origins, challenges and solutions. Int J Med Microbiol. 2013;303(6-7):287-292.

24. Iduh UM, Chollom CS, Nuhu A, Spencer THI, Nuru MB, Ashcroft OF, et al. Nosocomial infections in post-operative wounds due to Staphylococcus aureus and Pseudomonas aeruginosa in Benue State, Nigeria. Afr. J. Microbiol. Res. 2015;9(36):1989-1996.

25. Mofikoya BO, Neimogha MI, Ogunsola FT, Atoyebi OA. Predictors of surgical site infections of the abdomen in Lagos, Nigeria. Nig Q J Hosp Med. 2011;21(2):124-128.

26. Iregbu KC, Uwaezuoke NS, Nwajio-Princewill IP, Eze SO, Medugu N, Shettima S, et al. A profile of wound infections in National Hospital Abuja. Afr. J. Clin. Exper Microbiol. 2013;14(3):160-163.

27. Mama M, Abdissa A, Sewunet T. Antimicrobial susceptibility pattern of bacterial isolates from wound infection and...
their sensitivity to alternative topical agents at Jimma University Specialized Hospital, South-West Ethiopia. Ann Clin Microbiol Antimicrob. 2014;13:14. DOI: 10.1186/1476-0711-13-14

28. Sonawane J, Kamath N, Swaminather R. Bacterial profile of surgical site infection and their antibiogram in a tertiary care hospital-Mumbai. Bombay Hosp J. 2010;52(3):358-361.

29. Jido T, Garba I. Surgical site infection following caesarean section in Kano, Nigeria. Ann Med Health Sci Res. 2012;2(1):33-36. DOI: 10.4103/2141-9248.96934

30. Raza MS, Chander A, Ranabhat A. Antimicrobial susceptibility patterns of the bacterial isolates in post-operative wound infections in a tertiary care hospital, Kathmandu, Nepal. Open Journal of Medical Microbiology. 2013;3:159-163.

31. Sani RA, Garba SA, Oyewole OA, Ibrahim A. Antibiotic resistance profile of gram positive bacteria isolated from wound infections in Minna, Bida, Kontagora and Suleja Area of Niger State. J Health Sci. 2012;2(3):19-22. DOI: 10.5923/j.health.20120203.01

32. Shittu AO, Oyedara O, Abegunrin F, Okon K, Raji A, Taiwo S, et al. A multicentre study on the characterization of methicillin-susceptible and resistant staphylococci in Nigeria. BMC Infectious Diseases. 2012;12:286.

33. Onyedibe KI, Bode-Thomas F, Nwadike V, Afoloranmi T, Okolo MO, Uket O, et al. High rates of bacteria isolates of neonatal sepsis with multidrug resistance patterns in Jos, Nigeria. Ann Pediatr Child Health. 2015;3(2):1052.

34. Etok CA, Edem EN, Ocham E. Aetiology and antimicrobial studies of surgical wound infections in University of Uyo Teaching Hospital (UUTH) Uyo, Akwa Ibom State, Nigeria. Open Access Scientific Reports. 2012;1(7):2-5. DOI: 10.4172/scientificreports.341.

35. Bbosa GS, Wong G, Kyegombe DB, Ogwal-Okeng J. Effects of intervention measures on irrational antibiotics / antibacterial druguse in developing countries: A systematic review. Health. 2014;6(2):171-187.

36. Sanya TE, Titilayo OF, Adisa R, Segun JS. Use of antibiotics among non-medical students in a Nigerian University. Afr Health Sci. 2013;13(4):1149-1155. DOI: 10.4314/ahs.v13i4.41

37. Sapkota AR, Coker ME, Goldstein RER, Atkinson NL, Sweet SJ, Sopeju PO, et al. Self medication with antibiotics for the treatment of menstrual symptoms in southwest Nigeria: A cross-sectional study. BMC Public Health. 2010;10:610. DOI: 10.1186/1471-2458-10-610

© 2016 Adejumo et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.