

Knowledge and perception regarding surgical antibiotic prophylaxis among physicians in the department of obstetrics and gynecology

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ABSTRACT

Background: Evidence shows that compliance with surgical antibiotic prophylaxis (SAP) among obstetricians and gynecologists is poor. This study evaluates the knowledge and perceptions regarding SAP among doctors in Obstetrics and Gynecology units.

Methods: This was a cross-sectional study conducted among physicians in the Department of Obstetrics and Gynecology in two public tertiary hospitals in Nigeria. Data was collected using a 30-item validated and pre tested self-administered questionnaire, and analyzed using SPSS.

Results: A total of 41 respondents (response rate: 68.3%) returned the survey with a male preponderance (61%). Medical officers (Senior Registrars and Registrars) constituted almost two-third (63.4%) of the respondents. Only 26.8% had attended a workshop, seminar, conference or clinical meeting regarding SAP. Most respondents were not aware of the most common organism that causes surgical site infection and the appropriate time and duration of SAP. However, majority (90%) knew that the inappropriate use of SAP could lead to antibiotic resistance. More than two-third agreed that SAP malpractices were due to the lack of knowledge about SAP and poor awareness regarding antibiotic resistance. More than 90% agreed that education, audit and feedback, and guidelines would improve compliance with SAP. Respondents with 6–10 years working experience had significantly higher knowledge score than those with 1–5 years experience. Respondents who had not attended any workshop or course pertaining to SAP had more positive perception.

Conclusion: Respondents demonstrated inadequate knowledge of SAP and most of them were aware that inappropriate use of SAP could lead to antibiotic resistance.

Key words: Gynecologists; knowledge; obstetricians; perception; surgical antibiotic prophylaxis.

Introduction

Healthcare associated infections (HAIs) cause morbidity and mortality among hospitalized patients^[1] and surgical site infection (SSI) is one of the most common HAIs.^[2] In Nigeria, evidence shows that SSI represents approximately 31% of all HAIs and is ranked second after urinary tract infections.^[3] The

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prevalence of SSI ranges between 9.1% and 30.1% in Nigeria^[4,6] with higher rates reported in Obstetrics and Gynecology unit compared to Surgical unit.^[3] SSIs are associated with significant clinical and economic implications, however, these infections are potentially preventable using surgical antibiotic prophylaxis (SAP), infection control and blood glucose control.^[7-9] Surgical antibiotic prophylaxis is a proactive strategy involving the administration of antibiotic (s) before incision to prevent the occurrence of SSIs.^[10] The efficacy of SAP depends upon the choice of antibiotic, dose, timing, and duration.^[10] However, surgeon's compliance with SAP guidelines is low.^[10] In Nigeria, the use of broader spectrum and redundant antibiotics, suboptimal timing, and extended duration of SAP have been previously reported.^[11-13]

The implications of surgeon's non compliance include: increased risk of SSIs and the emergence and spread of antibiotic resistance. Inappropriate antibiotic selection, suboptimal dose, and timing make patients vulnerable to SSIs,^[14] whereas the prolong duration of SAP increases the risk of antibiotic resistance by 6-folds.^[15] SSIs are major causes of antibiotic resistant infections. Wound specimens have been reported to constitute 19%–75% of methicillin resistant *Staphylococcus aureus* isolates in Nigeria.^[16] Previous studies have highlighted the lack of knowledge regarding SAP among orthopedic surgeons^[17] and anesthetists.^[18] However, studies that evaluated the knowledge and perception of obstetricians and gynecologists regarding the same topic are scarce. Therefore, the objective of this study was to evaluate the knowledge and perception towards SAP among obstetricians and gynecologists. The result of the survey was used to design and implement antibiotic stewardship interventions.

Material and Methods

Study design and setting

This was a cross-sectional study conducted among obstetricians and gynecologists in two tertiary hospitals in Nigeria in August 2016. The study was conducted at Aminu Kano Teaching Hospital, Kano and Ahmadu Bello University Teaching Hospital, Zaria. The result of the survey was used to design antibiotic stewardship interventions to improve compliance with SAP.

Study participants and sample size

The respondents were physicians working in the Department of Obstetrics and Gynecology in the two hospitals who agreed to participate in the survey. All professional cadre were included. A convenient sample of 60 physicians (30 in each hospital) in the department was selected to participate in the study.

Development of survey instrument

The survey used in this study was developed after a comprehensive review of previous literature^[17,19] and guidelines for surgical antibiotic prophylaxis.^[20,21] A 30-item survey, which consists of three sections: (a) demographic characteristics, (b) knowledge of surgical antibiotic prophylaxis, and (c) perception regarding surgical antibiotic prophylaxis was developed. The survey was validated by 2 senior consultant obstetrician and gynecologist, and a Professor who has expertise in questionnaire design. The survey was modified based on the comments of the reviewers before a pilot test was conducted among 11 physicians who were eventually excluded from the study. The Cronbach's alpha for the knowledge and perception sections was 0.70 and 0.60, respectively.

Data collection

A convenient sampling method was used and the survey was self-administered. The questionnaire was distributed by hand to the participants across all professional cadres in the department (House officer, Medical officers, and consultants). Participation was voluntary and respondents were informed that their responses were confidential and anonymous. Respondents were given the option to complete the survey at the time they were administered or return them by hand at a later date.

Data analysis

Data was analyzed using IBM Statistical Package for Social Sciences (IBM SPSS®) version 23. Respondents' demographic characteristics, knowledge, and perception were presented as frequencies and percentages. Chi Square and Fisher exact Test (for small sample size) were used to determine the association between knowledge and perception questions and respondent's characteristics. The responses were transformed into scores using the following criteria: 1 and 0 for strongly agree/agree, and neutral and disagree/strongly disagree, respectively. Negative questions were reverse coded. Mann-Whitney U and Kruskal-Wallis Tests were used to determine the differences in the knowledge and perception scores based on the characteristics of the respondents.

Results

Demographic characteristics of the respondents

Overall, 41 respondents returned the survey (response rate was 68.3%). There were more male (61%) respondents and most of the respondents (61%) were in the 30–39 years age range. Approximately two-third (63.4%) of the respondents were Medical Officers (Senior Registrars and Registrars). There were only 11 (26.8%) respondents who had attended a workshop, seminar, conference, or clinical meetings regarding principles of SAP. Table 1 demonstrates the demographic characteristics of all the respondents.

Knowledge of surgical antibiotic prophylaxis

Almost all the respondents were aware that SAP should be administered before caesarean section. However, less than half (46.3%) of the respondents were aware that *Escherichia coli* is not the most common cause of SSI and that antibiotic used extensively for therapeutic purpose should not be selected for SAP. Approximately 49% did not know that administering SAP after surgery is associated with a higher risk of SSI. Most (90.2%) respondents were aware that overuse of SAP could cause antibiotic resistance. About 44% of the respondents did not know that SAP should be discontinued within 24 hours after completion of surgery. Table 2 shows the frequency and percentage of correct response to the questions in the knowledge section.

Perception of obstetricians and gynecologists regarding surgical antibiotic prophylaxis

More than one-third of the respondents strongly agreed/agreed that ampicillin/cloxacillin has similar antibiotic

prophylaxis efficacy as ceftriaxone. Most (70.7%) of the respondents strongly agreed/agreed that single dose SAP was not inferior to multiple doses. Approximately three-quarter agreed or strongly agreed that the prolonged use of SAP was due to poor awareness about antimicrobial resistance. An overwhelming majority of the respondents (90.2%) agreed/strongly agreed that lack of knowledge was the reason behind SAP malpractices. Most of the respondents (at least 90%) agreed/strongly agreed that educational strategy, development and implementation of local protocol, and audit and feedback would reduce the inappropriate use of SAP [Table 3].

Association between knowledge of surgical antibiotic prophylaxis and respondents' characteristics

Work experience, awareness regarding WHO guidelines for SAP, professional cadre and attendance of workshop, seminar, conference or clinical meetings were significantly associated with awareness of certain items in the knowledge section. Respondents with 6–10 years working experience, Medical officers, and those who had heard of WHO guidelines for SAP were more aware that antibiotics used for SAP should be different from those usually chosen for first-line treatment of infections ($P < 0.05$). Respondents who had not attended SAP course or workshop demonstrated higher knowledge regarding alternative antibiotics in patients with beta-lactam hypersensitivity ($P = 0.015$). The association between respondent's characteristics and other questions in the knowledge section was not significant.

Association between perception regarding surgical antibiotic prophylaxis and respondents' characteristics

Respondents who were aware of the WHO guidelines for SAP (47%) were significantly more likely to strongly disagree/disagree that ampicillin/cloxacillin and ceftriaxone have similar efficacy with respect to SAP than those who had not heard of the guidelines (0.0%). Respondents with more working experience were more likely to strongly agree/agree that the prolong use of SAP was due to poor awareness about antimicrobial resistance, and that audit and feedbacks could be used to improve SAP practice. House officers (44.4%) were less likely to strongly agree/agree than consultants (100%) and medical officers (88.0%) that prolonged use of SAP was due to lack of knowledge regarding SAP; $P = 0.048$. In addition, house officers (70%) were less likely to strongly agree/agree that audit and feedback can improve practice compared to consultants (100%) and medical officers (100%); $P = 0.023$.

Difference in overall knowledge and perception score based on respondents' characteristics

Mann-Whitney U and Kruskal-Wallis tests demonstrated that work experience (knowledge) and attendance at workshop/

Table 1: Demographic characteristics of all the respondents

| Variable | Frequency | Percentage |
|--|-----------|------------|
| Gender | | |
| Male | 25 | 61.0 |
| Female | 16 | 39.0 |
| Age (years) | | |
| 20 - 29 | 6 | 14.6 |
| 30 - 39 | 25 | 61.0 |
| 40 - 49 | 10 | 24.4 |
| Professional cadre | | |
| Consultant | 5 | 12.2 |
| Medical officer | 26 | 63.4 |
| House officers | 10 | 24.4 |
| Work experience (years) | | |
| <1 | 5 | 12.5 |
| 1 - 5 | 7 | 17.5 |
| 6 - 10 | 19 | 47.5 |
| >11 | 9 | 22.5 |
| Awareness of WHO guidelines for surgical antibiotic prophylaxis | | |
| Heard and used it | 19 | 46.3 |
| Heard but not used it | 16 | 39.0 |
| Never heard about it | 6 | 14.6 |
| Attendance at workshop, seminar, conference or clinical meetings pertaining to principles of surgical antibiotic prophylaxis | | |
| Yes | 11 | 26.8 |
| No | 30 | 73.2 |
| Period of attendance (years ago) | | |
| <1 | 3 | 27.3 |
| 1 - 2 | 6 | 54.5 |
| 3 - 5 | 2 | 18.2 |

Note: ABUTH : Ahmadu Bello University Teaching Hospital; AKTH: Aminu Kano Teaching Hospital; WHO: World Health Organization

Table 2: Respondents' response to items regarding knowledge of surgical antibiotic prophylaxis at both hospitals

| Statement | Correct response | |
|--|------------------|------------|
| | Frequency | Percentage |
| Patients undergoing caesarean section should receive surgical antibiotic prophylaxis | 40 | 97.6 |
| Surgical wound can be contaminated by microorganisms both from endogenous and exogenous sources | 41 | 100 |
| Escherichia coli is the most common organism that causes surgical site infections | 19 | 46.3 |
| Surgical antibiotic prophylaxis effectively prevents surgical site infections | 39 | 95.1 |
| The antibiotics used for prophylaxis should be different from those usually chosen for first-line treatment of established infections | 16 | 39.0 |
| Use of broad spectrum antibiotic could lead to antibiotic resistance | 19 | 46.3 |
| Clindamycin and vancomycin are suitable alternatives for surgical antibiotic prophylaxis in patients with beta lactam hypersensitivity | 22 | 53.6 |
| The risk of surgical site infection is higher when antibiotic prophylaxis is administered after surgery compared to pre-operative administration | 21 | 51.2 |
| The excessive and inappropriate use of surgical antibiotic prophylaxis is a risk factor for antimicrobial resistance | 37 | 90.2 |
| Long duration of antibiotic prophylaxis does not lower risk of surgical site infection | 21 | 51.2 |
| The optimal duration of surgical antibiotic prophylaxis should not exceed 24 hours after the completion of surgery | 23 | 56.1 |
| Additional dose of antibiotic prophylaxis should administered in the theatre when duration of surgery exceeds 3 hours | 39 | 95.1 |

Table 3: Respondents' response to statements pertaining to perception of surgical antibiotic prophylaxis

| Statement | Response, frequency (%) | | |
|---|-------------------------|----------------------------|----------------------------|
| | Strongly agree/Agree | Neither agree nor disagree | Strongly disagree/Disagree |
| Ampicillin/cloxacillin has similar efficacy when compared to ceftriaxone for prevention of surgical site infections | 18 (43.9) | 6 (14.6) | 16 (39.0) |
| Single dose antibiotic prophylaxis is not inferior to multiple doses for prevention of surgical site infections | 29 (70.7) | 6 (14.6) | 6 (14.6) |
| Prolonged use of antibiotics for surgical antibiotic prophylaxis is due to poor awareness about antimicrobial resistance | 31 (75.6) | 4 (9.8) | 4 (9.8) |
| Duration of antibiotic prophylaxis should be prolonged because Nigerian hospitals are different in terms of microbial contamination | 28 (68.3) | 6 (14.6) | 7 (17.1) |
| Inappropriate use of antibiotics for surgical prophylaxis could be attributed to poor knowledge regarding principles of surgical antibiotic prophylaxis | 37 (90.2) | 3 (7.3) | 1 (2.4) |
| The general perception of clinicians regarding the protective role of antibiotics is a factor contributing to inappropriate use of antibiotics for surgical prophylaxis | 30 (73.2) | 5 (12.2) | 4 (9.8) |
| Antibiotic resistance would undermine our capacity to treat or prevent infectious complications associated with surgery | 32 (78.0) | 4 (9.8) | 2 (4.9) |
| Education of obstetrician and gynecologist can be used to improve antibiotic prophylaxis practice | 38 (92.7) | 2 (4.9) | 0 (0.0) |
| Audit and feedbacks regarding antibiotic prophylaxis could be used as a strategy to improve use of antibiotics for surgical prophylaxis | 37 (90.2) | 3 (7.3) | 0 (0.0) |
| Development and implementation of a local protocol will reduce inappropriate use of antibiotics prophylaxis | 39 (95.1) | 1 (2.4) | 0 (0.0) |

a=1 missing datum; b=2 missing data; c=3 missing data

seminar/conference regarding SAP (perception) were the factors that influenced total knowledge and perception scores. Respondents with 6–10 years working experience had significantly higher knowledge score (10.0; interquartile range (IQR): 3.0 out of 12.0) than those in the other categories. Pairwise comparison using Mann-Whitney U Test showed that respondents with 6–10 years working experience had higher knowledge score (10.0; IQR: 3.0) than those with 1–5 years working experience (7.0; IQR: 3.0; $P = 0.002$). Respondents who had attended workshop/seminar/conference or clinical meeting had significantly lower (median: 7.0; IQR: 5.0) positive perception towards SAP than their counterparts who had no attendance (median score: 8.0; IQR: 2.0). There was

no significant difference in the knowledge and perception scores based on other respondents' characteristics. Table 4 describes the differences in overall knowledge and perception scores based on respondents' characteristics.

Discussion

The current study found that most of the respondents had heard about WHO guidelines for SAP and this observation was consistent with finding among orthopedic surgeons in Nigeria.^[17] In addition, only a quarter of the respondents had attended workshop/seminar/conference/clinical meetings pertaining to the principles of SAP. This finding demonstrates

Table 4: Differences in overall knowledge and perception scores based on respondents' characteristics

| Variable | Median knowledge score (IQR) | P | Median perception score (IQR) | P |
|--|------------------------------|--------------|-------------------------------|--------------|
| Gender | | | | |
| Male | 8.0 (3.0) | 0.721 | 7.0 (1.5) | 0.307 |
| Female | 9.0 (3.7) | | 8.0 (2.0) | |
| Age (years) | | | | |
| 20 - 29 | 7.0 (2.7) | 0.854 | 7.5 (5.5) | 0.336 |
| 30 - 39 | 8.0 (3.5) | | 7.0 (2.5) | |
| 40 - 49 | 9.0 (3.2) | | 8.0 (1.2) | |
| Professional cadre | | | | |
| Consultant | 9.0 (3.5) | 0.111 | 8.0 (3.0) | 0.318 |
| Medical officer | 9.0 (3.0) | | 8.0 (2.0) | |
| House officers | 7.0 (1.5) | | 6.5 (4.5) | |
| Work experience (years) | | | | |
| <1 | 7.0 (3.0) | 0.010 | 7.0 (6.0) | 0.705 |
| 1 - 5 | 7.0 (2.0) | | 8.0 (3.0) | |
| 6 - 10 | 10.0 (3.0) | | 8.0 (2.0) | |
| >11 | 8.0 (3.0) | | 8.0 (2.5) | |
| Awareness of WHO guidelines for surgical antibiotic prophylaxis | | | | |
| Heard and used it | 8.0 (3.0) | 0.708 | 8.0 (3.0) | 0.917 |
| Heard but not used it | 7.5 (3.7) | | 8.0 (1.7) | |
| Never heard about it | 9.50 (3.7) | | 7.5 (2.0) | |
| Attendance at workshop, seminar, conference or clinical meetings pertaining to principles of surgical antibiotic prophylaxis | | | | |
| Yes | 7.0 (3.0) | 0.828 | 7.0 (5.0) | 0.023 |
| No | 9 (4.0) | | 8.0 (2.0) | |

that most of the physicians who prescribed SAP lack training and this could explain the inappropriate use of SAP by obstetricians and gynecologists.^[11] More than half of the respondents did not know the most common bacteria that cause SSIs as was the case among orthopedic surgeons.^[17] Lack of knowledge regarding the microbiology of SSI is a precursor for the inappropriate selection of antibiotic for SAP because prescribers would make attempt to cover a wide range of organisms. The implication of this malpractice is increase in the use of broad spectrum antibiotics and antibiotic resistance.

This study observed that only 50% of the respondents knew the appropriate timing and duration of SAP. The lack of knowledge would lead to suboptimal timing and prolonged duration of SAP as evident in a recent study.^[11] Inappropriate timing of SAP, particularly post surgical administration, diminishes the efficacy of SAP and increases the risk of SSI.^[22] In addition, the extended use of SAP is associated with increase in the risk of antibiotic resistance.^[15] These findings highlight the danger that patients who undergo surgery are exposed to when the prescriber is not adequately equipped with information regarding the timing and duration of SAP. The good news is that most of the respondents are aware that excessive and inappropriate use of SAP could lead to antimicrobial resistance, and this is an indicator that training of the physicians could improve SAP practice. This hypothesis

was confirmed by studies that demonstrated that educational training for obstetricians significantly increase compliance with SAP.^[23, 24]

The current study also found that respondents with 6–10 years working experience had significantly higher knowledge of SAP than those with 1–5 years working experience. This indicates that educational interventions should be targeted at young professionals, although it is more appropriate if it is all-encompassing. We hypothesized that professional cadre would affect the knowledge of SAP, however, there was no significant difference between them and this could be due to the small sample size in the current study. Another finding of our study is that more than two-third of the respondents agreed that single dose SAP was not inferior to multiple doses in the prevention of SSI. However, most of the respondents strongly agreed/agreed that duration of SAP should be prolonged in Nigerian hospitals due to differences in terms of microbial contamination. This implies that the physicians believe that single dose SAP is not applicable in Nigerian hospitals citing inadequate infection control practices. An overwhelming majority of the respondents supported the use of interventions including: education, audit and feedback, and guidelines to improve compliance with SAP. Evidence has shown that these interventions are effective in optimizing SAP practice.^[25] The current study revealed that respondents with attendance in workshop/course regarding

SAP had significantly lower positive perception towards SAP than those without attendance. The reason (s) for this outcome is unclear, additional studies are required to unveil the reason for this negative association. The current study has a number of limitations including a small sample size despite the inclusion of two hospitals. This study was conducted in only two urban tertiary hospitals, and as such the findings are not generalizable. Some questions require remembering historical information, and therefore the study is prone to recall bias.

Conclusion

Physicians in the department of obstetrics and gynecology demonstrated inadequate knowledge regarding SAP and those with higher working experience demonstrated significantly higher knowledge. Majority of the respondents support the implementation of persuasive antibiotic stewardship interventions including education, audit and feedback and guidelines to improve SAP practices.

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Conflicts of interest

There are no conflicts of interest.

References

- Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 1990s: Attributable mortality, excess length of hospitalization, and extra costs. *Infect Control Hosp Epidemiol* 1999;20:725-30.
- Allegranzi B, Nejad SB, Combescure C, Graafmans W, Attar H, Donaldson L, *et al.* Burden of endemic health-care-associated infection in developing countries: Systematic Review and Meta-Analysis. *Lancet* 2011;377:228-41.
- Ige OK, Asuzu MC, Adesanmi AA. Hospital-acquired infections in a Nigerian tertiary health facility: An audit of surveillance reports. *Nig Med J* 2011;52:239-43.
- Jido T, Garba I. Surgical-site infection following cesarean section in Kano, Nigeria. *Ann Med Health Sci Res* 2012;2:33-6.
- Nwankwo E, Edino S. Seasonal variation and risk factors associated with surgical site infection rate in Kano, Nigeria. *Turk J Med Sci* 2014;44:674-80.
- Nwankwo EO, Mofolorunsho CK, Akande AO. Aetiological agents of surgical site infection in a specialist hospital in Kano, north-western Nigeria. *Tanz J Health Res* 2014;16:1-9.
- Aiken AM, Karuri DM, Wanyoro AK, Macleod J. Interventional studies for preventing surgical site infections in sub-Saharan Africa-A systematic Review. *Int JSurg* 2012;10:242-9.
- WHO. WHO Guidelines for Safe Surgery 2009: Safe Surgery Saves Lives. Geneva: World Health Organization; 2009.
- Smaill FM, Grivell RM. Antibiotic prophylaxis versus no prophylaxis for preventing infection after cesarean section. *Cochrane Database Syst Rev* 2014;CD007482.doi: 10.1002/14651858.CD007482.pub3.
- Ng RS, Chong CP. Surgeons' adherence to guidelines for surgical antimicrobial prophylaxis-Areview. *Australas Med J* 2012;5:534-40.
- Abubakar U, Sulaiman SS, Adesiyun AG. Utilization of surgical antibiotic prophylaxis for obstetrics and gynaecology surgeries in Northern Nigeria. *IntJ Clin Pharm* 2018;40:1037-43.
- Ajibade A, Akinniyi O. Timing of prophylactic antibiotic administration in an orthopedic hospital in a developing country. *Sahel Med J* 2013;16:144-7.
- Abubakar U. Antibiotic use among hospitalized patients in northern Nigeria: A multicenter point-prevalence survey. *BMC Infect Dis* 2020;20:86. doi.org/10.1186/s12879-020-4815-4.
- Harbarth S, Samore MH, Lichtenberg D, Carmeli Y. Prolonged antibiotic prophylaxis after cardiovascular surgery and its effect on surgical site infections and antimicrobial resistance. *Circulation* 2000;101:2916-21.
- Montes CV, Vilar-Compte D, Velazquez C, Golzarri MF, Comejo-Juarez P, Larson EL. Risk factors for extended spectrum β -lactamase-producing *Escherichia coli* versus susceptible *E. coli* in surgical site infections among cancer patients in Mexico. *SurgInfect* 2014;15:627-34.
- Abubakar U, Sulaiman SA. Prevalence, trend and antimicrobial susceptibility of Methicillin Resistant *Staphylococcus aureus* in Nigeria: A systematic review. *J Infect Public Health* 2018;11:763-70.
- Madubueze CC, Umaru H, Alada A. Attitudes of Nigerian orthopaedic surgeons to the use of prophylactic antibiotics. *IntOrthop* 2015;39:2161-5.
- Alagbe-Briggs O, Obembe BO. A survey on selection and administration of perioperative antibiotics by anaesthetists. *West Afri J Med* 2013;32:3-7.
- Ajibade A, Olaitan P. Knowledge, attitude and practice of perioperative antibiotic prophylaxis among nurse-anaesthetists in Nigeria. *Niger J Med* 2014;23:142-8.
- Van Eyk N, van Schalkwyk J, Yudin MH, Allen VM, Bouchard C, Boucher M, *et al.*; Infectious Diseases Committee. Antibiotic prophylaxis in gynaecologic procedures. *J ObstetGynaecol Can* 2012;34:382-91.
- van Schalkwyk J, Van Eyk N, Yudin MH, Boucher M, Cormier B, Gruslin A, *et al.*; Infectious Diseases Committee. Antibiotic prophylaxis in obstetric procedures. *J ObstetGynaecol Can* 2010;32:878-84.
- de Jonge SW, Gans SL, Ateama JJ, Solomkin JS, Dellinger PE, Boermeester MA. Timing of preoperative antibiotic prophylaxis in 54,552 patients and the risk of surgical site infection: A systematic review and meta-analysis. *Medicine (Baltimore)* 2017;96:e6903.
- Wang J, Dong M, Lu Y, Zhao X, Li X, Wen A. Impact of pharmacist interventions on rational prophylactic antibiotic use and cost saving in elective cesarean section. *Int J ClinPharmacol Ther* 2015;53:605-15.
- Abubakar U, Sulaiman SAS, Adesiyun AG. Impact of pharmacist-led antibiotic stewardship interventions on compliance with surgical antibiotic prophylaxis in obstetric and gynecologic surgeries in Nigeria. *PLoS one* 2019;14:e0213395.
- Levy SM, Phatak UR, Tsao K, Wray CJ, Millas SG, Lally KP, *et al.* What is the quality of reporting of studies of interventions to increase compliance with antibiotic prophylaxis? *J AmColl Surg* 2013;217:770-9.