Acta Scientific Pharmaceutical Sciences (ISSN: 2581-5423)

Volume 2 Issue 9 September 2018

Research Article

Antibiotic Usage in Surgical Prophylaxis: A Prospective Observational Study in the Surgical Ward of Nekemte Referral Hospital

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Received: May 17, 2018; **Published**: August 16, 2018

Abstract

Background: Surgical antimicrobial prophylaxis guidelines are considered as important interventional tools for antimicrobial resistance. Guideline compliance was poor across different countries and thus results in an inappropriate and overuses use of antibiotics.

Objective: To evaluate the selection, timing and duration of prophylactic antibiotic administration in surgical patients in Nekmte Referral Hospital (NRH).

Method: Prospective, facility based cross-sectional study was conducted from 1st April to 30th June 2017. Data were collected using data abstraction format among surgical inpatient prescribed surgical prophylaxis. Surgical antimicrobial prophylaxis guidelines were used as data assessment protocols. SPSS version 21.0 was used for data entry and analysis. Descriptive statistics and binary logistic regression were used for analysis.

Results: The mean age of the study participants was 36.7 years with the preponderance (58%) of male patients. The average hospitalization period was 8.6 days ± 4.8 days. Majority of the participants were from the general surgical ward (60.1%) and were clean (40.7%). Most of the surgical cases were gastrointestinal (39.2%). Only 10.6% of the drug selections comply with ASHP guideline. Surprisingly, none of the selections were compliant to the national STG of the country. About 84% of the study participants received ceftriaxone. Majority of the prophylactic antibiotics (75.8%) were administered for greater than 24 hours and above half (52.3%) of the antibiotics were administered preoperatively. Emergent surgery procedures (AOR = 2.89, 95% CI: (1.09 - 9.10) and being a male patient (AOR = 3.10, 95% CI: 1.07 - 8.98) were associated with inappropriate preoperative antibiotic administration. Patients admitted to Gynecology and obstetrics ward was less likely to receive surgical prophylaxis for greater than 24 hours (AOR = 0.07, 95% CI: 0.01 - 0.81).

Conclusion: Surgical antibiotic usage was far below the guideline recommendation. Patients admitted gynecology and obstetrics ward were more likely to comply with the antimicrobial duration recommendation. The timing was most likely to be inappropriate among male patients and patients on emergent surgery. Availability and awareness creation on the antibiotic drugs and the guidelines were important interventions recommended for appropriate surgical antimicrobial use.

Keywords: Guidelines; Compliance; Surgical Antibiotic Prophylactics; West Ethiopia

Introduction

Surgical antibiotic prophylaxis (SAP) is a very brief course of antibiotics initiated closely before the start of operative procedures to reduce postoperative surgical site infections (SSIs) [1]. SSI is one of the major complications of operative procedures and is also among the most common nosocomial infections [2]. SSI denotes a significant burden in terms of morbidity, mortality and healthcare costs [3].

Guidelines based on high-quality studies have reported that appropriate surgical antimicrobial prophylaxis is among the effective measures for preventing SSI [4]. For optimal benefit, determining the appropriate indication, selecting agent that covers the likely pathogen on wound contamination, and administering sufficiently high bactericidal concentrations during the whole period that the incision is open for risk of bacterial contamination is required [4,5].

A wide variation of compliance on antimicrobial prophylaxis usage was seen in various surgical procedures [6]. Noncompliance was reported as high on selection, timing and duration of antimicrobial prophylaxis use whereas indication and dose were relatively more satisfactory parameters [6,8]. The variation in practice across different setups could be attributed to the variation in the published guidelines, the lack of acceptance of the guideline among the surgeons, and the lack of awareness and availability of the guideline to service delivering professionals or setups [6,7].

Including our country, findings from different countries had reported that guideline compliance was poor and thus SAP was used inappropriately [7-10]. Thus, inappropriate use of surgical antibiotics has to be well-thought-out in order to achieve an overall reduction in morbidity, mortality and healthcare cost. One study done at Jimma University (southwestern Ethiopia) tried to assess the likely factors for poor preoperative timing and duration [9]. Another study in Ayder referral hospital (Northern Ethiopia) investigates the guideline concordance regardless of assessing the contributing factors. This study is a hybrid of the two methods in that it not only addresses the guideline concordance but also tried to assess the likely factors contributing for guideline non-adherence in terms of drug selection, preoperative timing and duration of surgical antimicrobial prophylaxis.

The assessment of SAP utilization was done in comparison to the guidelines in the area. Since there was no guideline prepared by the hospital; adherence was assessed based on the country national Standard Treatment Guideline (STG) [5] and the American Society of Health-System Pharmacists (ASHP) guideline [4].

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This study was done to identify gaps and set appropriate recommendations to improve future utilization of surgical antimicrobial prophylaxis. Hence it was aimed at evaluating the selection, timing and duration of prophylactic antibiotic administration in surgical patients in Nekmte Referral Hospital (NRH). The study can be used for guiding the hospital decision on surgical antibiotic usage and for policy direction. It can also be inferred for future supplementary surveys for similar setups.

Methods

Study setting and period

The study was conducted in the surgical wards of Nekemte Referral Hospital (NRH) during the period of 1st April to 30th June 2017 for three consecutive months. Nekmte is located at 331 km from west of Addis Ababa. The hospital has different departments and wards like outpatient department (OPD), medical wards, gynecology and obstetrics ward, pediatrics ward and general surgical wards. The general surgical ward has 49 beds with a 14 bed separated orthopedic ward. Almost all the recording systems of the hospital during the study period were carried manually.

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Study design

A 3-month long facility based cross-sectional study was employed to assess antibiotic usage in surgical prophylaxis.

Study population

All patients attending the gynecologic and obstetrics, general surgical and orthopedic wards during the study period were considered as the study population and those that fulfill the inclusion criteria were included.

Inclusion criteria

Using a convenient sampling method 153 adult patients (aged 18 and above) who underwent clean, clean-contaminated and contaminated procedures in Nekmte referral hospital during the study period were included. However, patients in the emergency OPD and emergency obstetric wards were not included because of unmanageable patient flows for follow-up. Children and their caretakers, clients taking antibiotics for therapeutic purpose, the presence of infection and/or antibiotics before surgery schedule and those with dirty procedures were excluded.

Study variables

Dependent variables

- Compliance with surgical antibiotic usage to the national and International guidelines.

Independent variables

- Socio-demographic factors like sex, age, etc.
- Patient medical conditions
- Perioperative characteristics
- Antibiotic use patterns
- Demographics of antibiotic providers

Data Collection Process

Data abstraction format was prepared based on previously published studies [8-10]. It was pretested on 15 patients, modified accordingly and used for data collection. The data abstraction format was divided into five sections. (1) Patient demographic and medical data, (2) Surgical data (Class of surgery, type of surgery, time of Incision, shift surgery is done, duration of surgery, wound class, type of ward and length of hospital stay), (3) SAP usage data (antibiotic name, dose, frequency, preoperative administration time relative to incision and duration of prophylactic administration), (4) surgical antibiotic providers data (provider profession, sex, age and experience). Then finally (5) appropriate SAP usage assessment lists (indication, selection, duration, and timing) was recorded. Based on this, all relevant data were collected from patients' medical records. Would classification was performed with the consultation of a pre-informed surgeon. Data were collected by four trained Nurses working in the hospital under the supervision of the principal investigator.

Data Interpretation

The CDC Wound Classification [11] was used to categorize operative procedures into clean, clean-contaminated and contaminated. The appropriateness of SAP use was assessed against national STG and one of the most internationally recognized reputable guideline, ASHP [4,5]. The appropriateness was evaluated with regard to the necessity for SAP use (Indication), choice of antibiotic (selection), preoperative timing (timing) and total duration of prophylaxis (duration). If more than one drug was given, the regimen as a whole is considered for evaluation. Thus any deviation from the guideline of one or both of the antibiotics would lead to a final report of non-compliance with the guidelines recommendation. If an antibiotic was given while it was not indicated, the parameter of antibiotic selection was not evaluated. Regardless of this the timing and duration compliance were assessed for all antibiotics administered. The timing of administration was analyzed as in the intervals before and after incision.

Statistical analysis

The collected data for any deficit was checked and cleaned prior to data entry. Data were coded, cleaned, entered and analyzed with SPSS for Windows version 21.0. Descriptive statistics, such as means, standard deviations and percentages were used to summarize patient characteristics. Factors affecting compliance were assessed using binary logistic regression model. Those variables that had an association ($p < 0.05$) in the univariate model were entered into the final multiple binary logistic regression models. The odds ratio was used to report the statistical association. The association was declared at $P < 0.05$.

Operational definitions

The surgical antibiotic administration was considered (1) early preoperative administration if given earlier than 60 minutes before skin incision, (2) preoperative if within 60 minutes before skin incision, (3) perioperative if within 3hrs after skin incision and (4) postoperative if after 3hrs after skin incision. SAP selection was said to be (1) adequate/compliant: if the drug/s were namely recommended by the guideline, (2) narrow: when only one of the drug recommended by the guideline is used, and (3) Broader: when extra drug is added to the guideline recommendation (4) unrelated: if the drug name is not part of the recommendation list regardless of its relatedness to the recommended list or regardless of its spectrum of coverage.

Ethical consideration

The study was undertaken after ethical clearance is obtained from Department of Pharmacy, College of Health Sciences, Wollega University's ethical review committee. In addition, Nekmte Referral Hospital director was requested for ethical permission to conduct the study. To ensure confidentiality, name and other identifiers of patients, clinicians who prescribed and administered the antibiotics were not recorded on the data abstraction instruments.

Result

Socio-demographic characteristics of study participants

Medical records of 153 surgical patients administered with a prophylactic antibiotic were followed and evaluated. The mean age of the study participants was 36.7 years with a preponderance (58%) of male patients. The average hospitalization period was 8.6 days (standard deviation 4.8 days) with about 97% of the patients being discharged with improvement. Majority of the participants were from the general surgical ward (60.1%).

Variable	Frequency (N = 153) (%)
Age (Mean ± SD (Range)	36.7 ± 15.6 (18 - 95)
Sex	
Male	90 (58.8)
Female	63 (41.2)
LoS	8.6 ± 4.6 (3 - 33)
Final status	
Improved	149 (97.4)
Dead	4 (2.6)
Ward	
General surgical	92 (60.1)
Gynecology-obstetrics	38 (24.8)
Orthopedic	23 (15.0)

Table 1: Characteristics of surgical inpatients taking SAP in NRH from 1st April to 30th June, 2017.

SAP Providers' demographics

Except one, all of the study participants receive a prophylaxis provided by Nurses. Majority of Whom (76.5%) were females. Above half of the providers were in the age range of 30 - 40 years and most of them have an experience of 8-10 years (Table 2).

Age of provider	Frequency (n = 153) (%)
< 30 years	45 (29.4)
30 - 40 years	81 (52.9)
> 40 years	27 (17.6)
Sex of provider	
Male	36 (23.5)
Female	117 (76.5)
Experience of provider	
8 - 10 years	91 (59.5)
> 10 Years	62 (40.5)

Table 2: Socio-demographic characteristics of the surgical prophylaxis providers in NRH from 1st April to 30th June 2017.

Perioperative characteristics of surgical patients

Most of the surgical cases were gastrointestinal (39.2%) followed by gynecology and obstetrics (15.7%). Majority of the procedures were clean (40.7%), followed by clean-contaminated (32%). Thirteen (8.5%) patients had a urinary catheter. Most of the surgeries took 1 - 2 hours (56.2%) and about 67% of them were performed in the morning. Sixty-eight (44.4%) of the patients took 2 - 5 days course of antibiotics. Less than a quarter (20.9%) of the patients took surgical antibiotics for not greater than a day. About 80 percent of the antibiotics were started before surgical incision. Above fifty percent of the patients took the surgical antibiotics preoperatively, within one hour of surgical incision (Table 3).

Perioperative characteristics	Frequency (%)
Class of Surgery	
GI	60 (39.2)
Gynecology and Obstetrics	38 (24.8)
Orthopedic	24 (15.7)
Urologic	16 (10.5)
Head and neck	3 (2.0)
Others	12 (7.8)
Wound Class (n = 153)	
Clean	66 (43.1)
Clean-Contaminated	49 (32.0)
Contaminated	38 (24.8)
Presence of Catheter	
Yes (Catheter (13)	13 (8.5)
No	140 (91.5)
Duration of surgery (hours) (n = 153)	
< 1	66 (43.1)
1 - 2	86 (56.2)
> 2	1 (0.7)
Shift surgery done	
Morning	103 (67.3)
After	20 (13.1)
Before mid-night	26 (17.0),
After mid-night	4 (2.6)
Duration of prophylaxis administration (days)	
One day	32 (20.9)
2 - 5 days	68 (44.4)
6 - 7 days	34 (22.2)
8 - 14 days	15 (9.8)
> 15 days	4 (2.6)
Timing of prophylaxis	
Before incision	122 (79.7)
After incision	31 (20.3)
Timing compliance with the intervals (n = 153)	
Early	42 (27.5)
Pre-operation	80 (52.3)
Perioperative	20 (13.1)
Postoperative	11 (7.2)

Table 3: Preoperative characteristics of study participants at NRH from 1st April to 30th June, 2017.

Surgical type and procedures

Sixty (39.2%) surgical cases were gastrointestinal. Appendicitis is the most common GI diagnosis (19/60), followed by colorectal cases (17/60) making appendectomy the most frequently performed GI procedure. Among the 38 gynecology and obstetrics case, 33 were gynecologic only (17 Utero-vaginal prolapses). Out of 24 orthopedic procedures, 23 were different types of fractures. Eight external fixations and seven open reduction and internal fixations (ORIF) were the most commonly performed orthopedic procedures. Among the 16 urologic procedures, 12 were Prostatectomy followed by 3 hydrocelectomy procedures (Table 4).

Surgery type (F)	Diagnosis (F)	Procedure (F)	F (%)
GI			60 (39.2)
Gastro-duodenal/ General (11)	Perforated abdomen (4),	Repair with Graham's Patch (4)	
	Penetrating abdomen (2), blunt abdominal trauma (2)	Laparotomy (4)	
	Mesenteric cyst (1)	Excision (1)	
	Gastric outlet obstruction (1), Post-operative adhesion (1)	Gastrojejunostomy (1), Repair (1)	
Biliary Tract (3)	Cholelithiasis (2), gallbladder stone (1)	Cholecystectomy (2), Laparotomy (1)	
Appendectomy (19)	Appendicitis (19)	Appendectomy (19)	
Small bowel (7)	Small bowel obstruction (6),	R+A (6)	
Hernia (4)	Hernia (4)	Herniorrhaphy (4)	
Colorectal (17)	Large bowel obstruction (8),	R+A (6), laparotomy (2)	
	Colostomy (4),	Colostomy closure (2), Permanent colostomy (2)	
	Rectal Cancer (2), hemorrhoid (2), Perianal fistula (1)	Permanent colostomy (1), Hemorrhoidectomy (2), Fistulectomy (1)	
Gynecology and obstetric	Utero-vaginal prolapse (17)	Vaginal Hysterectomy (17)	38 (24.8)
	Myoma (9), Endometrial cancer (1)	Myomectomy (8), Total Abdominal Hysterectomy (2)	
	Adnexal Cyst/Tumor (6),	Salpingectomy (4), laparotomy (1), Cystectomy (1)	
	Antepartum hemorrhage /Uterine Rupture(5)	Laparotomy (2), TAH (2), Bilateral tubal ligation (1)	
Orthopedic surgery	Fracture (23)	Debridement (3), External Fixation (8), Gator (3), ORIF (6), TBW (3)	24 (15.7)
	Gangrene (1)	Amputation	
Urologic surgery			16 (10.5)
	BPH (12)	Prostatectomy (12)	
	Hydrocele (3)	Hydrocelecectomy (3)	
	Hydronephrosis (1)	R+A (1)	
Head and neck			3 (2.0)
	Goiter (3)	Thyroidectomy (3)	
Others surgeries			12 (7.8)
Skin and deep tissue (5)	Skin cancer (1)/ Lipoma (1)	Excision (2)	
	Fasciitis (1)/ Malunion (1)/Soft tissue injury (1)	Fasciectomy (1), skin graft (1), repair (1)	
Breast (2)	Breast mass/cancer	Mastectomy (2)	
Miscellaneous	Pelvic mass (1), Popliteal cysts (1),	Excision (2)	
	wound dehiscence (1)	Wound Closure	
	Stab injury (1), animal bite (1)	Laparotomy (2)	
Total			153 (100)

Table 4: Surgical type and procedures of surgical inpatients at NRH from 1st April to 30th June 2017.

F: Frequency; GI: Gastrointestinal; TAH: Total Abdominal Hysterectomy; R & A: Resection and Anastomosis; ORIF: Open Reduction and Internal Fixations; TBW: Tension Banding and Wiring.

Antibiotics used for prophylaxis

About 59% of patients took a single prophylactic drug and about 39% took a combination of two drugs. About 84% of the participants received Ceftriaxone. Metronidazole (35.3%) is the second most prescribed prophylactic antimicrobial followed by ampicillin (19.6%) (Table 5).

Variables	Frequency (n = 153) (%)
Number of prophylactic antibiotic(s) used (n = 153)	
One	90 (58.8)
Two	60 (39.2)
Three	3 (2.0
Name of Prophylactic antibiotics used	
Amoxicillin	1 (0.7)
Ampicillin	21 (13.7)
Cloxacillin	2 (1.3)
Ceftriaxone	66 (43.1)
Ceftriaxone + Ampicillin	6 (3.9)
Ceftriaxone + Ampicillin + Metronidazole	3 (2.0)
Ceftriaxone + Metronidazole	51 (33.3)
Ceftriaxone + Cloxacillin	3 (2.0)
Specific prophylactic antibiotic used per patient	
Ceftriaxone	129 (84.3)
Ampicillin	54 (35.3)
Metronidazole	30 (19.6)
Cloxacillin	5 (3.3)
Amoxicillin	1 (0.7)
Prophylactic antibiotic use duration (n = 153)	
Mean ± SD (range) (days)	5.5 ± 4.1 (1 - 24)

Table 5: Utilization pattern of SAP among surgical patients at NRH from 1st April to 30th June 2017.

SAP compliance to the guidelines

About 20% of the prophylactic drugs were given for cases that lack specific recommendation as per the ASHP guideline. Among the reaming (80.4%) recommended indications, only 10.6% of the selections were adequate/compliant with the guideline recommendation. Majority of the (67.5%) selections were unrelated to the recommendations and 19.5% were unnecessarily border than the guideline recommendations. On the other hand, surprisingly all of the administrations were non-concordant to the Ethiopian national STG for general hospitals (Table 6).

Prophylaxis Indication (n = 153)	STG		ASHP	
Indication compliance	**Frequency**	**%**	**Frequency**	**%**
Given with Indication	126	82.4	123	80.4
Given without indication	27	17.6	30	19.6
Selection compliance	**(n = 126)**		**(n = 123)**	
Adequate/ concordant	0	0	13	10.6
Narrow	0	0	3	2.4
Broader	42	33.3	24	19.5
Unrelated	84	66.7	83	67.5

Table 6: SAP use and selection compliance to national STG and ASHP guidelines among surgical patients in NRH from 1st April to 30th June 2017.

SAP duration and preoperative timing

Majority of the prophylactic antibiotics were administered for greater than 24 hours (75.8%) and about 48% of the administrations were not given in the appropriate preoperative period of within 0 to 60 minutes before incision as recommended by the guidelines (52.3) (Table 7).

Variable	Frequency (n = 153)	%
Duration less or equal to 24 hours		
Yes	37	24.2
No	116	75.8
Timing within 0 to 60 minutes prior to incision		
Yes	80	52.3
No	73	47.7

Table 7: Duration and timing of SAP among surgical inpatients in NRH from 1st April to 30th June 2017.

Factors affecting Timing and duration of SAP

Factors affecting the timing of SAP administration

Emergent surgery procedures (AOR = 2.89, 95% CI: (1.09 - 9.10) and being a male patient (AOR = 3.10, 95% CI: 1.07 - 8.98) were the two factors that were associated with the inappropriate timing of a prophylactic administration as per the guidelines (Table 8).

Factors associated with greater than 24 hour SAP use duration

The only ward of admission has an independent association with SAP use duration. Patients admitted to Gynecology and obstetrics ward were more likely to receive SAP for less than or equal to 24 hour days (AOR = 0.07, 95% CI: 0.01 - 0.81) than patients admitted to orthopedic ward (Table 9).

Variables	Timing (not within 60 minutes before incision)	COR (95% C.I.)	Sig.	AOR (95% C.I.)	Sig.
Sex (Male)	55 (61.1)	0.26 (0.13, 0.51)	0.000	3.10 (1.07, 8.98)	0.037
Ward					
Surgical	52 (56.5)	1.00 (0.40, 2.51)	1.000	1.11(0.32, 3.83)	0.873
Genecology and obstetric	8 (21.1)	4.88 (1.57, 15.17)	0.006	0.76 (0.06, 8.79)	0.823
Orthopedic	13 (56.5)	[Reference]		[Reference]	
Surgery type (Emergent)	44 (57.9)	0.44 (0.23, 0.84)	0.013	2.89 (1.09, 9.10)	0.049
Wound class					
Clean	35 (53.0)	1.36 (0.60, 3.05)	0.459	1.66 (0.54, 5.08)	0.376
Clean-contaminated	15 (30.6)	3.48 (1.43, 8.46)	0.006	0.69 (0.21, 2.23)	0.525
Contaminated	23 (60.5)	[Reference]		[Reference]	
Greater than 24 hr SAP duration	10 (27)	3.21 (1.42, 7.23)	0.005	0.55 (0.18, 1.69)	0.292
Sex of the provider (Male)	27 (75.0)	0.22 (0.09, 0.50)	0.000	1.52 (0.36, 6.30)	0.568
Age of the provider					
Age (< 30 years)	12 (26.7)	12.10 (3.74, 39.16)	0.000	0.31 (0.03, 3.03)	0.312
Age (30 - 40 years)	39 (48.1)	4.74 (1.64, 13.74)	0.004	0.17 (0.02, 1.220	0.078
> 40 years	22 (81.5)	[Reference]		[Reference]	
Experience of provider (≤ 10 years)	35 (38.5)	2.53 (1.31, 4.92)	0.006	1.40 (0.53, 3.67)	0.494

Table 8: Factors that determine the timing of SAP administration among surgical patients in NRH from 1st April to 30th June, 2017.

Variables	> 24 hour SAP use duration	COR (95% C.I.)	Sig.	AOR (95% C.I.)	Sig.
Sex (Male)	82 (91.1)	8.74 (3.63, 21.06)	0.001	1.01 (0.18, 5.52)	0.994
Surgery type (emergent)	66 (86.8)	3.56 (1.58, 8.04)	0.002	1.14 (0.33, 3.94)	0.839
Ward					
Surgical	86 (93.5)	3.02 (0.78, 11.75)	0.11	2.82 (0.62, 12.81)	0.178
Genecology and obstetric	11 (28.9)	0.09 (0.02, 0.31)	0.000	0.07 (0.01, 0.81)	0.033
Orthopedic	19 (82.6)	[Reference]		[Reference]	
Sex of Provider(Male)	32 (88.9)	3.14 (1.03, 9.58)	0.044	1.18 (0.29, 4.88)	0.817
Prolonged LOS (1)	63 (66.3)	0.19 (0.07, 0.51)	0.001	0.78 (0.22, 2.80)	0.702
Experience (≤ 10 years)	61 (67.0)	0.26 (0.11, 0.64)	0.003	1.94 (0.44, 8.50)	0.378

Table 9: Factors associated with prolonged SAP use duration among surgical patients in NRH from 1st April to 30th June 2017.

Discussion

In this study, the average hospitalization period of the study participants was 8.6 days (standard deviation 4.8 days) with about 97% of the patients being discharged with improvement (Table 1). Most of the surgical cases were gastrointestinal (39.2%) followed by gynecology and obstetrics (15.7%). Majority of the procedures were clean (40.7%) followed by clean-contaminated (32%). Thirteen (8.5%) patients had a urinary catheter. Most of the surgeries took 1 - 2 hours (56.2%) and about 67% of them were performed in the morning (Table 4).

Unlike to the Palestine study [10], except one all of the study participants receive a prophylaxis provided by Nurses. Majority of Whom (76.5%) were females and all have an experience of at least 8 years. Although this study did not evidence, the Palestine study had shown the association of the health providers' variables with appropriate surgical prophylaxis usage [10].

Similar to studies reported in Ayder referral hospital (19.4%) [8] and in Nicaragua (23%) [12], in this study, 19.6% of the prophylactic antibiotics were given without indication as per the ASHP guideline [4,5]. Among the reaming (80.4%) recommended indications, only 10.6% of the selections were adequate/compliant to the ASHP guideline recommendation. Majority of the (67.5%) administrations were unrelated to the recommendations and 19.5% were unnecessarily border than the guideline recommendations. On the other hand, surprisingly all of the prophylactic selections were nonconcordant to the Ethiopian National STG for general hospitals. Similar evidence is noted from Ayder referral hospital report [8].

Ceftriaxone was excessively and inappropriately used for SAP in our study site, NRH. Similar to Ayder study [8] about 84% of the participants were given ceftriaxone despite the drug is not mentioned in the national STG of the country. As per the ASHP ceftriaxone is recommended only for high-risk biliary tract procedures and for colorectal surgery. This is because being a broad spectrum drug ceftriaxone can induce emergency resistance more likely than cefazolin and other widely used surgical prophylactic drugs.

Of the patients (n = 123) to whom surgical prophylaxis were indicated and administered; 89.4% (67.5% unrelated to the recommendations, 19.5% border and 2.4% narrower than the guideline recommendations) of thee selections were inappropriate. This supports the study from Ayder (North Ethiopia) (89.5%) [8] and Iran (92.5%) [18] but higher than studies from Sudan (64.4%) [17], Qatar (31.5%) [19] and Nicaragua (66.8%) [12].

In this study, one of the reported reasons for noncompliance was the use of agents that were unrelated to the SAP guideline recommendation. In addition, about 20% of the cases contain extra combinational drugs on the recommended regimen. Most of the unrelated cases were also much broader than the recommended prophylactic agent or had an unnecessary combination. Probably this may be because of the wrong generalization that broad/combination antibiotics are more effective in averting SSIs [13].

Including this study, as per the different studies conducted in our country, surgical antibiotics commonly practiced were neither part of the STG of the country nor the primary choice of the international guidelines. Therefore, what one should be skeptical to our country context is that some common custom on broad-spectrum antibiotic use has been held and communicated across (probably) all hospitals of the country that should be further investigated and intervened as early as possible. Probably, another factor to be investigated in line with this issue is the availability of the recommended drugs and the reasons behind in the given facility. For instance, in this case, despite cefazolin is available in the country, the Nekmte Referral Hospital drug list does not have the drug. In support of this, a study from Jordan [16] found that 68.1% of inappropriate antimicrobial selections for surgical prophylaxis were attributed to drug unavailability. Another study [15] also reported the importance of the hospital supply of availing antibiotics for surgical antimicrobial selection.

Despite the availability of first choice drugs, surgeons had been reported to fail to comply with the guideline recommendations. Some of the reasons mentioned as a barrier to adherence to the guideline were lack of agreement of surgeon's with guideline recommendations, lack of awareness of appropriate guidelines, and logistic limitations in the surgical wards [7].

Another common failure to guidelines compliance investigated in this study was prolonging surgical prophylaxis administration duration beyond the recommendation. Although the guidelines promote to end prophylactic administration within 24 hours [4,5], near to half (44.4%) of the administrations continued for up to five days. Comparable results were reported from a study in Iran (46%) [18], and in southwestern Ethiopia (50.7%) [9]. To be specific, in this study only less than a quarter (20.9%) of the patients' discontinued surgical antibiotics within a day. About 79% of the remaining antibiotics were given for greater than a day, without any reason. This result is comparable

with studies in Nicaragua (78.4%) [12] and Sudan (97%) [17], but much higher than a study Malaysia (20%) [14]. Guidelines basing on high-quality studies identified that prolonged use of antimicrobials may contribute to bacterial resistance; urging our setup to reconsider guideline-concordant use [4].

In this study, another area of focus that needs improvement as per the guideline recommendation was initial (preoperative) timing of surgical antimicrobial prophylaxis. About 48% of the prophylactic administrations were not given in the preoperative time range (within 60 minutes of surgical incision). Prophylactic antibiotics are more effective if administered as close as to skin incision time; especially within one hour before skin incision [4,5]. In this study, only 80 (52.3%) patients got administered within 60 minutes before skin incision. A similar finding was obtained from studies of Jimma University Specialized Hospital (56%) [9] and India [23].

Among the three factors assessed for guideline concordance, an inappropriate selection was not considered for association test because all of the selections are inappropriate as per the national STG and only colorectal surgery selections are found appropriate as per the ASHP guideline. The remaining two variables, duration, and preoperative timing were assessed. As a result, patients admitted to Gynecology and obstetrics ward were more likely to receive prophylaxis for less than or equal to 24 hours (AOR = 0.07, 95% CI: 0.01 - 0.81) than patients admitted to the orthopedic ward. This finding was shared with a study done in the west bank, Palestine [10], in which case gynecology and obstetrics department had much better adherence to the antibiotic duration guideline. On the other hand, emergent surgery procedures (AOR = 2.89, 95% CI: 1.09 - 9.10) and being a male patient (AOR = 3.10, 95% CI: 1.07 - 8.98) were the two factors that were associated with the inappropriate preoperative timing of a prophylactic administration. Emergency procedures may put the health workers under psychological or empathic stress and multiple care requirements that may probably result in poor timing. This implies that these patients should be the focus of care and the health professionals working in this area should be adequately trained on how to handle emergency conditions. Since I did not come up with related studies, the difference in sex of the patient is difficult to explain in this report but it will be an important area of investigation for future works.

Despite this study is a three-month long institution based cross-sectional study, the findings should be interpreted in light of the resultant limitations. Primarily, it is performed in an institution with a relatively small sample size. This would limit the generalizability of the study to other areas. In addition, the current study did not consider some important parameters of SAP namely route, dose and redosing. The dose and the route of administration might not be as such critical because these issues were usually more concordant with the guideline recommendations in our country context too [8]. Redosing might be not critical in this study where ceftriaxone was the most used drug with a long half-life. Furthermore, most of the data were retrieved from the medical records in which the accuracy of the data depends on hospital record quality. Therefore future studies should take these variables into consideration.

Conclusion

In conclusion, the selection and duration of prophylactic antibiotic administration were far below the guideline recommendation but the preoperative timing was about half times compliant [S6 and S7 Tables]. The timing of surgical antimicrobial prophylaxis was most likely to be inappropriate for male patients and patients on emergent surgery [S8 Table]. Patients admitted to gynecology and obstetrics ward were more likely to comply with the antimicrobial duration recommendation [S9 Table]. Availability and awareness creation on the antibiotic drugs and the guidelines were important interventions for appropriate surgical antimicrobial use.

Therefore, healthcare administration and other concerned authorities should work to improve compliance in accordance with guidelines.

Acknowledgments

The data collectors of this research and all staff members of the study sites as well as the patients during the data collection period should receive my heartfelt gratefulness.

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Volume 2 Issue 9 September 2018
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