ANTIMICROBIAL STEWARDSHIP: ASYSTEMATIC APPROACH TO COBACT ANTIMICROBIAL RESISTANCE IN SURGICAL PROPHYLAXIS

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KEYWORDS

antibiotic; appropriateness; prophylaxis; surgical; usage

ABSTRACT

Antibiotic prophylaxis is used to decrease the bacterial load in the wound to assist the natural host defenses in preventing the occurrence of surgical site infections. The present study aimed to investigate trends in using antibiotic prophylaxis in the surgical ward of a tertiary hospital and included collecting data concerning the use of antibiotic prophylaxis from medical electronic records. During 2022, most of the surgical patients received the most prescribed antibiotics were Ceftrixone (26.37%) and Cefixime/ amikacin (26.37%). The present study showed that there was a major problem in selecting the correct antibiotic and in the duration of its use compared with the recommendations of the surgical prophylaxis guideline that was issued by the Saudi Ministry of Health. Thus, there is an urgent need to improve the adherence to the recommendations of surgical antibiotic prophylaxis guidelines in order to reduce the occurrence of negative consequences

1. Introduction

Health care-associated infections (HCAIs) are infections that occur while receiving health care and that develop in health care facilities such as hospitals [1]. These infections first appear 48 h or more after patient admission or appear within 30 days after receiving health care [1]. HCAIs include catheter-associated urinary tract infections, ventilator associated pneumonia, central line-associated bloodstream infections, and surgical site infections (SSIs) [2]. These infections are common and result in a high mortality rate. In the United States, there are 1.7 million reported HCAIs cases each year, causing about 100,000 deaths [3]. Surgical site infection (SSI) is a common hospital-acquired infection that causes significant health problems and results in prolonged hospitalization and increased treatment cost, in addition to increased patient mortality and morbidity [4]. SSIs are defined as infections that occur within 30 days of a surgery or within 90 days if the surgery includes the insertion of prosthetic material [5]. The World Health Organization reported that the pooled prevalence of surgical site infections was about 11.2 per 100 surgical patients [6]. It is estimated that about 10% of hospitalized patients

in developing countries acquire HCAIs. Most of these infections are SSIs, which account for approximately 5.6% of surgically admitted patients [5].

Antibiotic prophylaxis is one of the measures used to decrease SSI incidence [7]. Antibiotic prophylaxis is used is to decrease the bacterial load in the wound to assist the natural host defenses in preventing the occurrence of an SSI [8]. Despite the effectiveness of prophylactic antimicrobials in preventing SSIs, the use of antibiotics is often incorrect [9]. Bedouch et al. stated that the inappropriate use of antibiotics occurs in 25% to 50% of general elective surgical procedures [10]. Thus, antibiotic prophylaxis is applied only if the costs and morbidity associated with infection are more than the costs and morbidity associated with antibiotic prophylaxis [11]. The unnecessary use of antibiotics and the use of broad-spectrum antibiotics increase the risk of resistance development [11]. Antimicrobial prophylaxis should be used for a short duration to reduce toxicity and antimicrobial resistance and decrease cost [12].

Ahmed et al. reported that surgeons in different Riyadh hospitals use preoperative antibiotic prophylaxis incorrectly [13]. Alghamdi et al. showed that although the Saudi Ministry of Health (MOH) devised a national antimicrobial stewardship plan to implement antimicrobial stewardship programs in Saudi hospitals, only 26% of hospitals reported the implementation of these programs [14]. Furthermore, Hammad et al. reported that in Aseer Hospital, the rate of adherence to preoperative and postoperative antibiotic prophylaxis guidelines was 36% and 56%, respectively, and that the average adherence rate was 46% [15]. Tolba et al. stated that there is a significant gap between current surgical antibiotic prophylaxis usage and international/national guidelines, and that there is a need for immediate action to ensure effective guideline adoption and implementation [16].

To improve the prescribing of antimicrobial prophylaxis, it is important to know the trends around prescribing antibiotics as well as the adherence to the recommendations of the guidelines. After that, appropriate antimicrobial stewardship practices should be implemented. The World Health Organization stated that the antimicrobial stewardship principles needing to be followed must give due consideration to the national and local context and the structure of the health system when carrying out antimicrobial stewardship activities [17]. In Saudi Arabia, the Ministry of Health devised a national antimicrobial stewardship plan that included a surgical prophylaxis guideline in 2018 to be implemented in governmental hospitals [18].

Although there are numerous studies on the use of antibiotics in general, there is a lack of studies on the use of antibiotic prophylaxis in our region. Therefore, the present study aimed to investigate trends in using antibiotic prophylaxis in the surgical ward of a tertiary hospital.

2. Materials and Methods

This was a systematic approach study that included collecting data about the use of antibiotic prophylaxis from medical electronic records. The study was conducted in the surgical ward of a tertiary hospital.

This study included reviewing the medical records of patients who had a surgical procedure in the surgical ward during 2022. So, patients of both genders and from all age groups who visited the surgical ward were included, and patients in other departments were excluded. The total number of antibiotics included tablets, capsules, suspensions, vials, and ampules. Topical antibiotics such as drops and ointments were excluded from this study (Figure 1). The collected data included the total number of patients who had surgeries and the number and percentage of patients who received surgical antimicrobial prophylaxis. Furthermore, the collected data included the number of different antibiotics that were used and the age and gender of the patients receiving the antibiotics. Moreover, we collected data about the prescribed dosage forms of different antibiotics and the usage duration of these antibiotics.

The data were collected using an Excel sheet and analyzed descriptively. The results were represented as numbers and percentages. The percentages were calculated by dividing each value by the total number and then multiplying the result by 100%. This study was approved by the ethical approval committee.

3. Results

Number and Percentage of Patients Who Received Antibiotics

Among 100 patients had surgeries. Most of these patients received antibiotics in IV and oral route (91%) and 9% of these patients did not use antibiotics in Pre-OP, all 100 patients used antibiotics in post-OP and 57 patients used antibiotic after discharge and 43 patients are not used antibiotics.

The Most Prescribed Antibiotics in the Surgical Ward

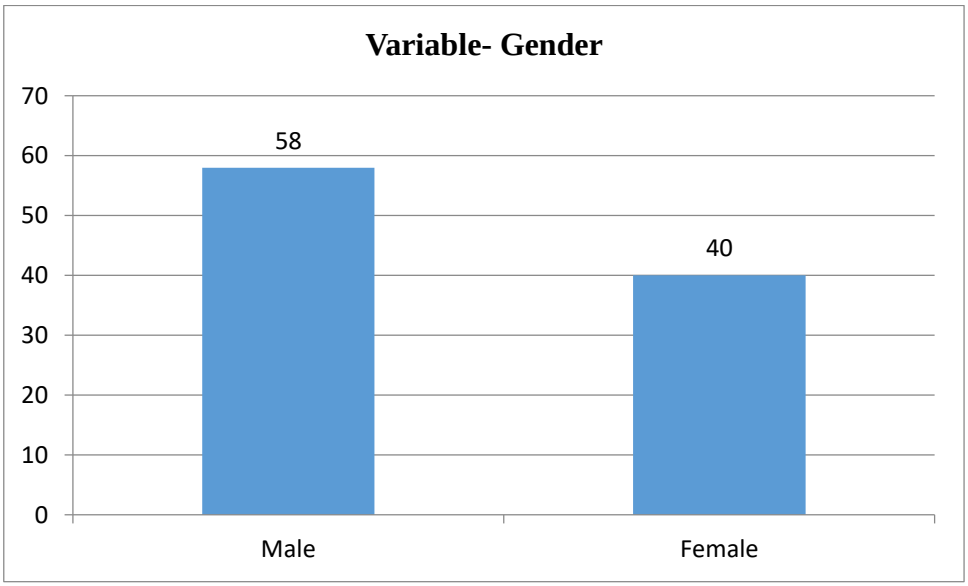
The most prescribed antibiotics were Ceftrixone (26.37%) and Cefixime/ amikacin (26.37%) during Pre-OP. after discharge Cefixime is the most used antibiotics.

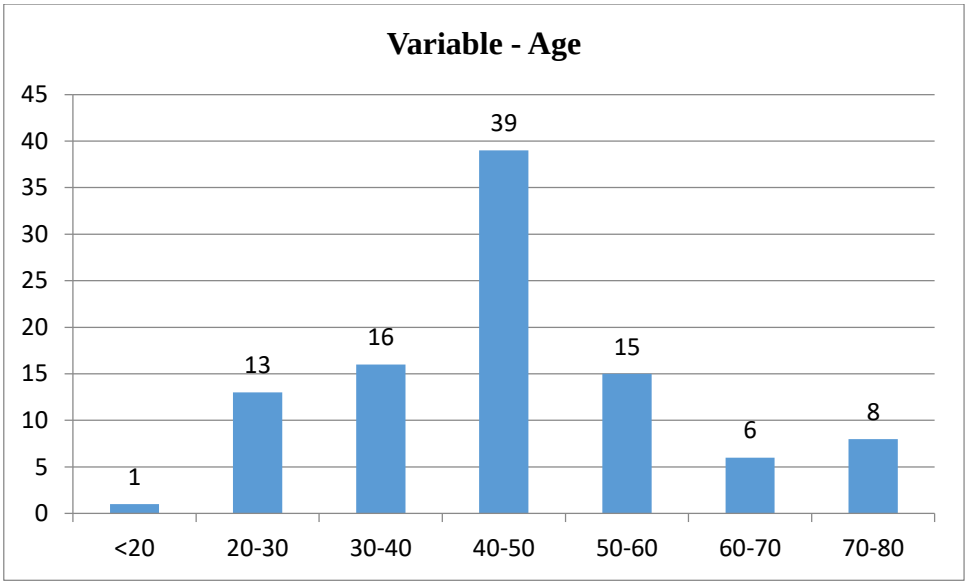
The Personal Data of the Patients Who Received Antibiotics in the Surgical Ward

Table 1 shows the personal data of the patients who received antibiotics. Most of the patients who received antibiotics were male (59.3%). Most of the patients were in the age groups of 40–50 years (43.95%), 30–40 years (17.58%), and 50–60 years (16.48%) and most of the patients were from rural 61 (67.03).

Table 1. The personal data of the patients who received antibiotics in the surgical ward.

Variable	Category	Number	Percentage
Gender	Male	58	59.18
	Female	40	40.81
Age	<20	1	0.01
	20-30	14	15.38
	30-40	16	17.58
	40-50	40	43.95
	50-60	15	16.48
	60-70	6	6.59
	70-80	8	8.79
Location	Rural	61	67.03
	Urban	32	35.16



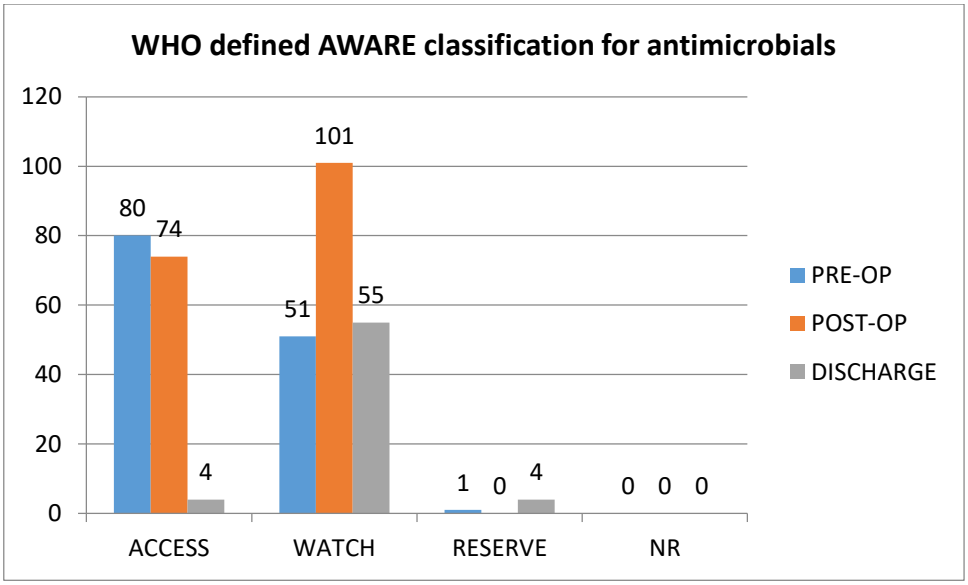


WHO defined AWARE classification for antimicrobials

98 prescriptions were randomly selected from orthopaedic department of a tertiary hospital. The analysis of the data showed that out of 98 patients 158 were falling under ACCESS category, 207 were administered antimicrobials from WATCH, The numbers accounting for RESERVE group was observed as 5. As per the study observation no patients were administered not recommended class of antimicrobials (Table 2).

Table 2: WHO defined AWARE classification for antimicrobials

AWARE CLASS	PRE-OP	POST-OP	DISCHARGE	TOTAL
ACCESS	80	74	4	158
WATCH	51	101	55	207
RESERVE	1	0	4	5
NR	0	0	0	0



WHO prescribing indicators

The study also considered WHO prescribing indicators to access the rationality of antimicrobials administered during the study period in the hospital and observed that the percentage of antibiotics administered were relatively high and there is a degree of variability observed generic name and parenteral administration of antimicrobials. There is a need to work to adherence the principals of practice form IV to oral conversion and generic name for prescribing the antimicrobials agents.

Table 3: WHO prescribing indicators

S. No	Indicators	Percentage
1	Avg no. of drug encountered	7.36
2	% of encounter with antibiotic	170
3	% In essential medicine list	100%
4	% Prescribed in generic name	54.08%
5	% Prescribed in Parenteral	161

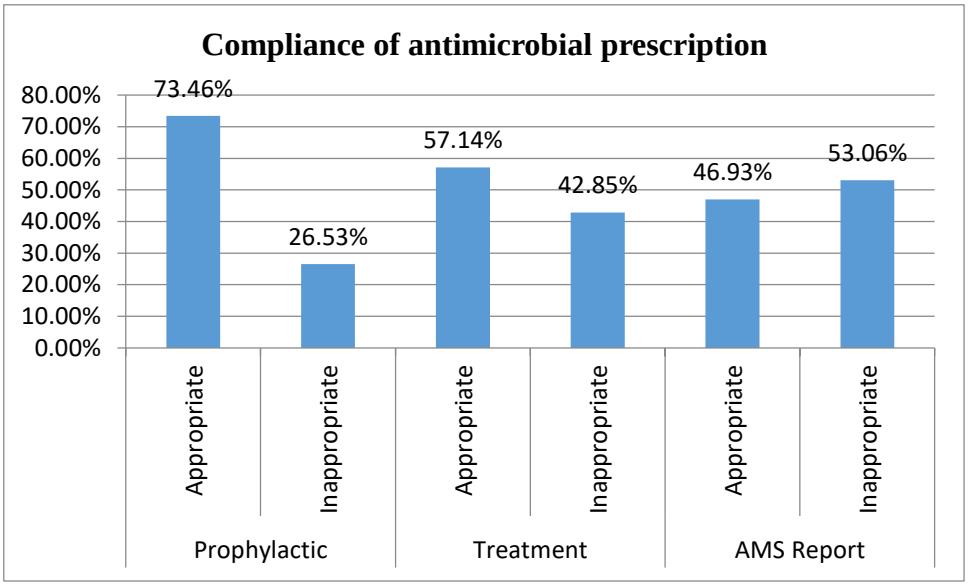
Compliance of antimicrobial prescription

The study aimed to promote the adherence of antimicrobial agents in practice based on WHO AWARE classification and considering the Hospital specific Antibiogram if it been implemented at the study site.

The overall observation of the study concluded that there is certain degree of inappropriateness in administration of antimicrobials which must be monitored and strict implications are to be made to curb the over use of antibiotics in tertiary care hospital.

Table 4: Compliance of antimicrobial prescription

Sl. No.	Antibiotic administered	Observation	Frequency
1	Prophylactic	Appropriate	72 (73.46%)
		Inappropriate	26 (26.53%)
2	Treatment	Appropriate	56 (57.14%)
		Inappropriate	42 (42.85%)
3	AMS Report	Appropriate	46 (46.93%)
		Inappropriate	52 (53.06%)

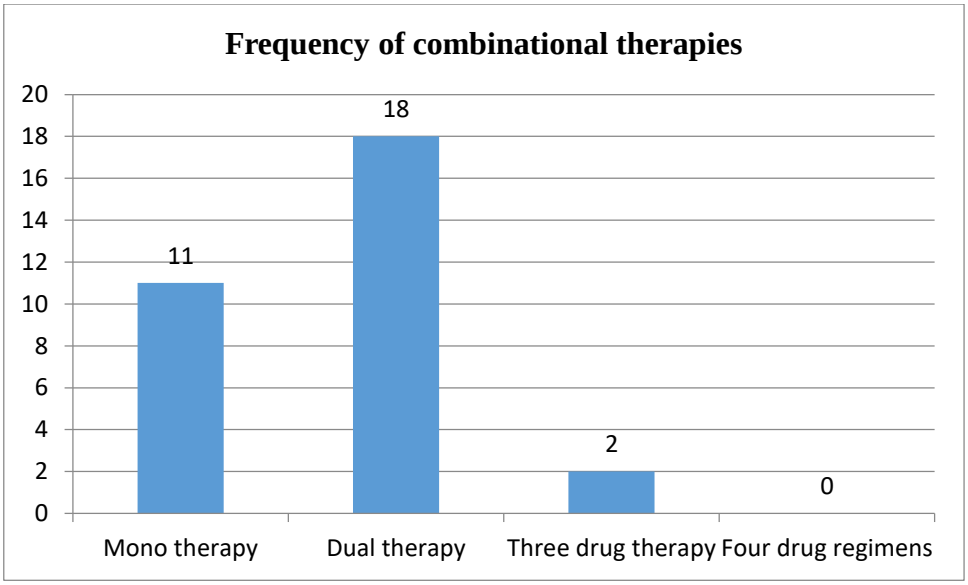


Frequency of combinational therapies

The study the observed antimicrobial drug regimen administered to the patients of orthopedic department during the study period and found that most of the prescriptions followed dual regimen (Table 5) the accountability of 3 drug regimen was also considered based on patient individual factors.

Table 5: Frequency of combinational therapies

S. No	Therapy	Frequency
1	Mono therapy	11
2	Dual therapy	18
3	Three drug therapy	2
4	Four drug regimens	0
5	Total	31



Antimicrobials used from WHO essential drug list

The most prescribed antibiotics were Ceftrixone (24.48%) and Cefixime/ amikacin (24.48%) during Pre-OP. after discharge Cefixime is the most used antibiotics.

Cephalosporin group was the commonly prescribed antimicrobial class followed by aminoglycosides Most prescribed individual drug from different antimicrobials group was Cefixime and Ceftrixone 24.48%, Cefuroxime 5.10% patients from the Cephalosporins, amoxicillin 5.10% from penicillin. The other commonly used antimicrobials were metronidazole and colistin. The drug was prescribed by generic namesas well as with trade names. The drugs in fixed dose combination were Cefixime with amikacin in 24.48% of the patients, Cefixime with amoxicillin + clavunalic acid 2.04%, Ceftrixone with metronidazole 2.04% , Cefoperazone salbactum with colistin 1.02, Cefoperazone salbactum/ amikacin 2.04%, Clindamycin/ amoxicillin + clavunalic acid 2.04%, Amoxicillin + clavunalic acid/ metronidazole 1.02%, Amikacin with cefuroxime 2.04% of patient.(Table 6). All the prescribed drugs were from the essential drug list.

Table 6: Antimicrobials used from WHO essential drug list

Drug class	**Antibiotic**	**No. of drug prescribed**	**Percentage**	**WHO model essential drug list**
Antibiotic in Pre-OP				
Cephalosporins	Cefixime	21	21.42	Yes
Cephalosporins, Aminoglycoside	Cefixime/ amikacin	24	24.48	Yes
Cephalosporins, Penicillins	Cefixime/ amoxicillin + clavunalic acid	2	2.04	Yes

Cephalosporins	Cefuroxime	5	5.10	Yes
Cephalosporins	Ceftrixone	24	24.48	Yes
Cephalosporins Imidazole	Ceftrixone/ metronidazole	2	2.04	Yes
Cephalosporins, Polymyxins	Cefoperazone salbactum/ colistin	1	1.02	Yes
Cephalosporins, Aminoglycoside	Cefoperazone salbactum/ Amikacin	2	2.04	Yes
Lincosamides, Penicillins	Clindamycin/ amoxicillin + clavunalic acid	2	2.04	Yes
Penicillins, Imidazole	Amoxicillin + clavunalic acid/ metronidazole	1	1.02	Yes
Penicillins	Amoxicillin + Clavunalic acid	5	5.10	Yes
Aminoglycoside	Amikacin/ cefuroxime	2	2.04	Yes
Antibiotic in Post-OP				
Cephalosporins	Cefixime	21	21.42	Yes
Cephalosporins, Aminoglycoside, Imidazole	Cefixime/ amikacin/ Metronidazole	18	18.36	Yes
Cephalosporins, Aminoglycoside	Cefixime/ Amikacin	26	26.53	Yes
Cephalosporins, Penicillins	Cefixime/Amoxicillin + Clavunalic acid	2	2.04	Yes
Cephalosporins, Lincosamides	Cefixime/ Clindamycin	2	2.04	Yes
Cephalosporins	Ceftrixone	15	15.30	Yes
Cephalosporins, Imidazole	Ceftrixone/ Metronidazole	4	4.08	Yes
Aminoglycoside	Amikacin	2	2.04	Yes
Aminoglycoside, Cephalosporins	Amikacin/ Cefuroxime	2	2.04	Yes
Aminoglycoside, Imidazole	Amikacin/ Metronidazole	1	1.02	Yes
Penicillins	Amoxicillin + Clavunalic acid	4	4.08	Yes
Penicillins, Imidazole	Amoxicillin + Clavunalic acid/ Metronidazole	1	1.02	Yes
cephalosporins, Polymyxins	Cefoperazone Salbactum/ Colistin	1	1.02	Yes
Cephalosporins, Aminoglycoside, Imidazole	Cefoperazone Salbactum/ Amikacin/ Metronidazole	1	1.02	Yes
Antibiotic in Discharge				
Cephalosporins,	Cefixime	45	45.98	
Cephalosporins,	Ceftrioxone	11	11.22	
Penicillins	Amoxicillin + Clavunalic acid	1	1.02	

4. Discussion

Infection in bone and joints is a potentially very serious condition and are difficult to treat and can cause significant morbidity and mortality. Most of the cases needs antimicrobial therapy but the irrational use of antimicrobials leads to a number of consequences in term of cost, drug interactions and hospital stay along with increased probability of bacterial resistance toward the commonly used antimicrobials. The present study was done in orthopaedic department where common diagnosis was fracture of bones and soft tissue infection.

In this study, antibiotic prophylaxis was administered appropriate to 73.46% and inappropriate to 26.53 of cases. Several studies have shown that antibiotics are used excessively and incorrectly for the prevention of SSIs [19–27]. This study also showed that the most prescribed antibiotic was ceftriaxone, and that there is a high rate of using broad-spectrum antibiotics. The surgical prophylaxis guideline that was issued by the Ministry of Health and was implemented in governmental hospitals in Saudi Arabia recommended the use of first- or second-generation cephalosporins as a first line for most surgeries and not ceftriaxone [18]. Similarly to this result, Alemkere reported that ceftriaxone was used excessively and inappropriately in surgical prophylaxis, and that about 19.5% of the patients received a broad-spectrum antibiotic other than the antibiotics that are recommended by the guideline [28]. Similarly, Mohamoud et al. stated that nearly 84% of the surgical patients were given ceftriaxone, despite the drug not being mentioned in the national guideline [29]. Moreover, Van Kasteren et al. found that despite the availability of first-choice antibiotics, surgeons had been reported to fail to comply with the guideline recommendations [30]. They also reported that the barriers to the adherence to the guideline were a lack of awareness of appropriate guidelines, a lack of agreement of surgeons with the guideline recommendations, and logistic limitations in the surgical wards [30]. On the other hand, Oh et al. reported that the selection of antibiotics for 78.2% of surgical patients was consistent with the guideline recommendations [31]. Moreover, Al-Azzam et al. found that preoperative antibiotic prophylaxis was employed in almost all surgical departments of hospitals, and the choice of improper antimicrobials was ascribed to drug unavailability [32]. This study also found that most of the patients received antibiotics for seven days or for five days, and only 1.08% of the patients received antibiotics appropriately for a maximum of one day. Perioperative antibiotic prophylaxis should normally be discontinued within 24 h after surgery completion [33]. The Ministry of Health surgical prophylaxis guideline states that antibiotics should be used once, and if the surgery takes several hours, another dose of antibiotic could be given, but for a maximum of 24 h [18]. Similarly, Parulekar et al. reported

that in a tertiary-care private hospital in India, the appropriateness of antibiotic selection was seen in 68%, and that the percentage of using the appropriate duration of antibiotics was 63% [34]. Musmar et al. found that in the Northwest Bank of Palestine, only 18.5% of surgical patients had appropriate antibiotic selection, and 31.8% of patients received antibiotics for an appropriate duration [35]. Moreover, Tourmousoglou et al. stated that for antibiotic prophylaxis in general surgery, the choice of antimicrobial agent was appropriate for about 70% of the patients and the duration of prophylaxis was optimal for about 36% [36]. Khan et al. reported that more than half (69%) of surgeons who participated in his study thought that antibiotics were overused in surgical procedures [37].

Furthermore, Oh et al. found that in the surgical ward at a tertiary hospital in Malaysia, prophylactic antibiotics were discontinued within 24 h after the operation in 77% of the cases [30]. Abdel-Aziz et al. reported that regarding antimicrobial prophylaxis in a tertiary general hospital, the overall use of antibiotics was 89%, but that the use of antibiotics did not match the recommended hospital protocols in more than 53% of cases [38]. They also reported that prolonged antibiotic use was the most common reason for nonadherence to antimicrobial prophylaxis guidelines (59.3%), followed by the use of an alternative antibiotic to that recommended in the protocol (31.5%) [38]. Gouvêa et al. conducted a review about the adherence to guidelines for surgical antibiotic prophylaxis and found that the rate of using the correct antibiotic choice ranged from 22% to 95%, and that the rate of the appropriate discontinuation of antibiotics ranged from 5.8% to 91.4% [39].

Further studies over a longer period of time are required to provide a baseline data of prescribing pattern of drugs in orthopedics because a longer study will have a greater number of patients and the quantitative measurements may be more representative of the population. Such type of studies provides necessary feedback to prescribing registered medical practitioners and may prove useful to formulate antibiotic policy to policy makers.

5. Limitation and Strength

The main limitation of the present study is that the rate of surgical site infections was not reported in the hospital, but the physicians informed that the rate of SSIs was less than 0.5%. This, the rate of surgical site infections (SSIs) might have been underestimated.

Another limitation is that the diagnosis of the patients and the type of surgeries performed were not mentioned in the electronic files. A strength of this study is that we can estimate the appropriateness of using an antimicrobial agents before a surgery by comparing the commonly prescribed antibiotics and the duration of antibiotics used with the recommendations of the Saudi MOH guideline, because the recommended prophylactic antibiotics for the majority of

surgeries were first-generation or second-generation cephalosporin antibiotics, and all of the prophylactic antibiotics should be used as a single dose or for a maximum of 24 h.

6. Conclusions

This study showed that antibiotics were administered to most of the surgical patients to prevent the occurrence of surgical site infections but that there was a major problem in selecting the correct antibiotic and in the duration of use compared with the recommendations of the surgical prophylaxis guideline. There is an urgent need to improve the adherence to the recommendations of surgical antibiotic prophylaxis guidelines to reduce the occurrence of negative consequences. Moreover, it is important to encourage all healthcare providers to attend workshops and to be trained in the appropriate use of antibiotics for surgical patients.

There is a need to develop strategies to implement the AMS programme in every tertiary care hospital to fight the threat posed by antimicrobial resistance in health care sector and need to update it on regular bases to improve the quality of life of patient and to reduce the economic burden.

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