

## Original Article

# An Audit of Perioperative Antimicrobial Prophylaxis: Compliance with the International Guidelines

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## INTRODUCTION

The utilization of antimicrobial prophylaxis for those surgical methodology is one of the measures used to keep the improvement of a surgical site infection (SSI).<sup>[1]</sup> SSIs altogether increment the length of hospital stay, morbidity, and mortality and along these lines deplete medicinal services framework assets.<sup>[2]</sup> Proper utilization of anti-infection agents can decrease the occurrence of SSI,<sup>[3]</sup> and the unsuitable use of antibiotics for prophylaxis increased drug toxicity and the emergence of antibiotic-resistant bacteria.<sup>[3]</sup>

In spite of the accessibility of universal and national rules for surgical prophylaxis, recent studies surveying the present routine of prophylaxis have demonstrated that overutilization of antimicrobial medications, unnecessary

## ABSTRACT

**Objective:** Antimicrobial prophylaxis has been demonstrated to lower the incidence of postoperative infection in nearly all types of surgery. The American Society of Health-System Pharmacists (ASHP) guideline summarizes current data on the appropriate use of antibiotic for surgical prophylaxis. The objective of this study was to assess and audit the use of antibiotics in a tertiary care center according to the recommendation of ASHP guideline. **Methods:** This cross-sectional study was performed using prospective data gathered from April to September 2015 in the surgical wards of Al Zahra Hospital, Isfahan, Iran. Antibiotic indication and choice, dose, dosing interval, route of administration, and timing of first administration and duration of prophylaxis were compared with the ASHP guideline recommendations. **Findings:** A total of 100 patients with the mean age of  $49.8 \pm 18.2$  years were recruited for this study. About 22% of procedures had full compliance with all guideline recommendations. The most frequently encounter noncompliance type were the duration of prophylaxis (14%) and appropriate agent choice (35%). Timing of the initial dose was appropriate in most of the procedures (42%). **Conclusion:** This study revealed that most of the prescribed antibiotics for surgical prophylaxis are not in accordance with standard treatment guideline. The density of antimicrobial use for preoperative antimicrobial prophylaxis is very high. Furthermore, the hospital should develop a formal strategy, including a local guideline for antimicrobial prophylaxis in surgical procedures.

**KEYWORDS:** *Antibiotic prophylaxis, guideline adherence, surgery*

utilization of wide range antibacterial and wrong planning and span are still hazardous.<sup>[4-10]</sup> Although a few studies have reported abuse of anti-infection agents in Iranian healing facilities, there are insufficient studies about the quality and of surgical prophylaxis in Iran.<sup>[5,11-15]</sup> In this study, we used the guidelines of the American Society of Health-System Pharmacists (ASHP)<sup>[16]</sup> to assess the appropriateness of antibiotic prophylaxis for surgical procedures in the large teaching hospital affiliated with Isfahan University of Medical Sciences (IUMS) in Isfahan, Iran.

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## METHODS

A prospective audit was undertaken between April and September 2015 in “Alzahra” teaching hospital, Isfahan, Iran, which is a tertiary referral hospital with 850 beds. Services cover all the major specialties, including general medicine, surgery, obstetrics and gynecology, urology, psychiatry and orthopedics except of pediatrics. The Ethic Committee of IUMS approved the study protocol. All patients aged  $\geq 18$  years admitted for elective surgery were recruited during the study.

Data were collected prospectively from PATIENT’S chart and entered on the data collection forms. The following information was noted: patient demographic information, ward, type of surgery, wound class, antibiotic therapy received (agents, doses, dose intervals, and route of administration, the number of doses, initiation times, and duration of administration), outcome of prophylaxis and outcome of patients. Compliance with recommendations of ASHP guidelines was assessed for every aspect of antibiotic prophylaxis. Patients who received antibiotic treatment for infections were excluded, as were patients for whom it was not possible to determine whether the antibiotic was given as treatment or prophylaxis.

The American College of Surgeons determines four classes of surgical wound types based on the wound’s level of contamination: clean, clean-contaminated, contaminated, and dirty-infected.<sup>[16]</sup> We determined type of wound based on the performed procedure.

The first criterion evaluated was preoperative antibiotic prophylaxis indication; if this criterion was assessed as inappropriate, the other criteria also considered as inappropriate. Antibiotic prophylaxis remedies considered as wrong if any of the surveyed criteria inappropriate (i.e., “inappropriate” indication or choice).

Each record’s parameters were evaluated against following criteria: Indication for prophylaxis: according to ASHP guideline recommendations; choice of antibiotics: According to the ASHP guideline recommendations; time of administration of first preoperative dose(s): Proper if given within 30–60 min before incision; duration of prophylaxis; dose and route of administration.

For patients who developed a wound infection during admission, only antibiotics prescribed before the onset of infection were enlisted; this was performed to separate prophylactic and treatment courses.

All statistical analyses were performed using SPSS version 20 (SPSS Inc., Chicago, IL, USA). Frequency and percentage were calculated and presented.

## RESULTS

A total of 100 patients reviewed in this study (mean age  $46.8 \pm 18.2$ ; male: 62). Patients ranged in age from 18 to 86 years. The types of surgery were as follows: Thorax (24%), general surgery (19%), orthopedic (18%) vascular surgery (14%), plastic surgery (13%), obstetrics-gynecologic (6%), and neurosurgical (6%). The most performed procedures are as follows: Thoracotomy ( $n = 7$ ), rhinoplasty ( $n = 5$ ) cholecystectomy ( $n = 4$ ), femoral and hip fixation ( $n = 4$ ) Endoscopic retrograde cholangiopancreatography ( $n = 3$ ), dilation and curettage ( $n = 3$ ), cesarean ( $n = 3$ ), and open reduction internal fixation ( $n = 3$ ). All of the reviewed procedures were elective. Most of the surgical wounds were clean (74%), or clean-contaminated (21%), and 5% were contaminated. Table 1 shows the proportion of procedures in which the antibiotic therapy prescribed agreed with the ASHP guideline recommendation for indications and regimens of antibiotic prophylaxis.

We found that antibiotic(s) were administered inappropriately for 47 procedures for which antibiotic prophylaxis was not indicated. The antibiotic used most frequently were cefazolin (in 66 procedures, 66%), metronidazole (in 18), ceftizoxime (in 14), clindamycin (in 13), ceftriaxone (in 11), vancomycin (in 10), and ceftazidime (in 9). Cefazolin was appropriately prescribed in 31 procedures. A total of 792 g of cefazolin was used for patients.

Of 36% of patients for whom a single antibiotic was indicated, 10% received two or more antibiotics. All the administration was consistent with the guideline recommendation in 35 procedures. The dose and dosing interval were appropriate for 43% of procedures. All the antibiotics were administered intravenously.

For 42 patients from 100 patients, antibiotic prophylaxis was started 30–60 min before induction of anesthesia. For five patients, prophylaxis was started  $>2$  h after induction of anesthesia. The surgery duration was  $>3$  h in nine patients; only two of them received an additional dose of antibiotic (cefazolin) during surgery.

**Table 1: Compliance with the American Society of Health-System Pharmacists’ therapeutic guidelines on antimicrobial prophylaxis in surgery ( $n=100$ )**

Variables	Value
Appropriate agent used	35
Appropriate initiation time of prophylaxis	42
Appropriate duration of prophylaxis	14
Appropriate dose	26
Appropriate administration route	49
Appropriate decision making regarding use or nonuse of antibiotic	53
Compliance with all recommendations	22

Data are presented as number of surgical procedures

**Table 2: Results of preoperative antimicrobial prophylaxis in different surgical wards**

Variables	Surgical wards					
	Thorax	Orthopedic	General surgery	Plastic surgery	Vascular surgery	Obstetrics/gynecology
Number of patients (male/female)	24 (16/8)	18 (16/2)	11 (11)	13 (7/6)	14 (9/5)	14
Age (years)	50.7±14.2	45.6±20.4	46.9±21	37.3±19.6	54.1±20.3	43.7±12.4
Type of surgical wound (clean/ clean-contaminated/contaminated)	13/11	16/0/2	8/2/1	10/3	10/3/1	13/0/1
Appropriate agent (%)	9 (37.5)	8 (44.4)	4 (36.3)	5 (38.5)	5 (35.7)	3 (21.4)
Appropriate initiation time (%)	14 (58.3)	7 (38.8)	4 (36.6)	5 (38.5)	3 (21.4)	5 (35.7)
Appropriate duration (%)	3 (12.5)	1 (5.5)	3 (27.2)	3 (23.1)	2 (14.3)	1 (7.1)
Appropriate dose (%)	12 (50)	8 (44.4)	5 (45.4)	5 (38.5)	5 (35.7)	6 (42.8)
Appropriate decision (%)	14 (58.3)	8 (44.4)	7 (63.6)	5 (38.5)	6 (42.9)	8 (57.2)
Compliance with all recommendation (%)	6 (25)	8 (44.4)	3 (27.3)	3 (23.1)	5 (35.7)	4 (28.6)

Data are presented as mean±SD, or *n* (%), where applicable. SD=Standard deviation

The duration of prophylaxis was consistent with the guideline recommendation for 14 patients. The mean duration of prophylaxis for the remaining 37 patients was  $6.7 \pm 5.9$  days (range, 2–25 days). For 27 of these patients, the duration of prophylaxis was >72 h. The mean length of hospital stay was  $6.1 \pm 5.9$  (range, 1–32 days).

All of our patients stay alive and discharged from the hospital. Infection developed in eight of these patients despite the use of antibiotics for surgical prophylaxis. From these, only one patient received appropriate prophylaxis. Table 2 shows the patient characteristics and adherence to ASHP guideline recommendations in different surgical wards in our hospital. Different surgical wards had the most compliance with the guideline at the appropriate initiation time of prophylaxis and the least compliance with appropriate duration of prophylaxis. Orthopedic surgeons followed by vascular surgeon had the most overall compliance with all guideline recommendations (>90%).

## DISCUSSION

The results of this study demonstrate that about all of the patients got anti-microbial for surgical prophylaxis regarding the sort of surgical intercession. General consistency with the assessment criteria was accomplished in 22% of the procedures. These outcomes show that the surgical group knew about the estimation of antibiotics in counteracting SSI, additionally, exhibit a general absence of attention to international standards by human health care providers, and reflected the impact from an absence of clinical guidelines.

The ASHP recommends prophylaxis with cefazolin as first choice and single agent for most procedures (clean and clean-contaminated).<sup>[16]</sup> Only 35% of our patients received the appropriate agent; use of >1 drug without any indication for multidrug prophylaxis, and use of antibiotics not recommended for prophylaxis, such as

third-generation cephalosporins, are the most common errors in antibiotic selection. This misuse and overuse of antibiotics are associated with the emergence of bacterial resistance and increase in health-associated costs. Inappropriate selection of antibiotics for prophylaxis has been shown in some studies such as Sudan (56.3%),<sup>[6]</sup> Iran (54%).<sup>[13]</sup> On the other hand, antibiotic choice for prophylaxis has been better (regarding appropriateness) in studies from the United States (95% of courses were appropriate),<sup>[17]</sup> Brazil (75%),<sup>[18]</sup> and China (95%).<sup>[19]</sup>

For the greater part of patients, the duration of prophylaxis was extended beyond single doses. Other studies reported the same problem.<sup>[5-11]</sup> Extended use of prophylactic antimicrobials has been linked with the appearance of bacterial resistance, the risk of superinfection and drug toxicity.<sup>[20]</sup> Prophylaxis was started at the right time in most of our procedures. None of our patients developed an infection during hospitalization possibly because of continuing prophylaxis beyond the recommended duration. Therefore, we couldn't judge about the outcome of preoperative antibiotic prophylaxis.

The rate of the wrong indication for antibiotics was high among the general surgery and obstetrics/gynecology discipline. The possible reasons behind the higher rate of improper antibiotic use in these wards include distinctive of surgical systems, complex surgical methods, and higher surgery rates. Proper pharmacists' specialists alongside strict supervision over surgeons at local hospitals might be valuable and helpful in the pattern of proper antibiotic utilization.

Although antimicrobial prophylaxis can decrease the incidence of SSI, this benefit must weigh against the risks of adverse drug reactions, the emergence of resistant bacteria and the direct monetary cost.<sup>[21]</sup> One potential strategy to enhance antimicrobial practice in hospitals is institutionalization, either by receiving

an international guideline or by developing a local hospital guideline. Institutionalization efforts should be administered by a board of trustees that incorporates specialists, anesthesiologist, microbiologists, pharmacists, and infection control departments. Guidelines should be based on the hospital's specific bacterial epidemiology patterns, the best literature evidence, and surgeon favorite. The standardized protocol should then be provided to surgeons, in an effort to achieve consensus, before execution. A few studies have demonstrated that guidelines can enhance the quality of antibiotic use. Currently, there are no national standard or guideline about the preoperative antimicrobial prophylaxis in Iran. At our study setting, neither guideline nor consensus are available. The poor practice documented by the present study could be enhanced with effective interventions.

Our study had some limitations. First, the results do not include microbiology outcome parameters and process parameters. Second, in some cases, the timing of antibiotic administration had not documented in the patient's hospital file; third the cost-effectiveness and feasibility of ASHP guidelines in our region has not been documented. We choose ASHP as an available and international guideline.

This study revealed that most of the prescribed antibiotics for surgical prophylaxis are not in accordance with standard treatment guideline. A preface of local prescribing guideline together with proper educational interventions is required to improve the excellence of preoperative antibiotic use.

## AUTHORS' CONTRIBUTION

Sarah Mousavi designed the study, analyzed the data and drafted the manuscript. Elham Zamani collected and interpreted the data and Farnak Bahrami revised the manuscript.

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## Conflicts of interest

There are no conflicts of interest.

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