

## Original Article

# Adherence to American society of health-system pharmacists surgical antibiotic prophylaxis guidelines in a teaching hospital

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## ABSTRACT

**Objective:** Surgical site infections are the second most common type of adverse events occurring in hospitalized patients, whereas an estimated 40-60% of these infections are thought to be preventable. Choice of regimen, administration timing or duration of antibiotic prophylaxis is reported to be inappropriate in approximately 25-50% of cases. We tried to evaluate an antibiotic administration pattern for surgical antibiotic prophylaxis in a teaching hospital.

**Methods:** This study was conducted at the general surgery and orthopedic wards of a teaching hospital affiliated with Mazandaran University of Medical Sciences. The medical records of admitted patients who underwent different surgical procedures were reviewed. Compliance was assessed with the recommendations of the American Society of Health-System Pharmacists' guidelines for every aspect of antibiotic prophylaxis. All data were coded and analyzed by SPSS16 software using Student's t-test and Chi-square test.

**Findings:** During 1 year, 759 patients who underwent different surgeries were included in the study. Mean age of patients was  $32.02 \pm 18.79$  years. Hand and foot fractures repair were the most frequent surgery types. About 56.4% of administered prophylactic antibiotics were in accordance with the American Society of Health System Pharmacists (ASHP) guidelines regarding prophylaxis indication. The most commonly antibiotic used was cefazolin and antibiotic choices were appropriate in 104 of 168 surgical procedures (62%). Gentamicin, metronidazole and ceftriaxone were the most frequently antibiotics that used inappropriately. Only in 100 of 168 procedures, duration was concordant with the ASHP guideline, whereas in 68 procedures, duration was longer than recommended time. In 98 procedures, the dose was lower and in one procedure, it was higher than recommended doses.

**Conclusion:** Although such guidelines have been in place for many years, studies showed that much inappropriate antibiotic use as prophylaxis and poor adherence to guidelines are still major issues. It is essential for surgeons to be aware to consider the best antibiotic choices, dose and duration based on reliable guidelines for antibiotic prophylaxis.

**Keywords:** Adherence; antibiotic prophylaxis; American Society of Health System Pharmacists guidelines; surgical

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## INTRODUCTION

Surgical site infections (SSIs) are a major cause of postoperative illness resulting in increased

morbidity, mortality, and do have a major impact on the cost of health.<sup>[1]</sup> SSIs account for 14-16% of all hospital-acquired infections and are a common complication of care, occurring in 2-5% of patients after clean extraabdominal operations and in up to 20% of patients undergoing intraabdominal procedures. Among surgical patients, SSIs account for 40% of all such infections.<sup>[2]</sup> By implementing projects to reduce SSIs, hospitals could recognize savings of \$3152 and reduction in extended length of stay by 7 days on each patient developing an infection.<sup>[3-9]</sup>

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Patients with SSIs are 5 times more likely to be readmitted to the hospital, 60% more likely to be admitted to the Intensive Care Unit, twice as likely to die, and are hospitalized 7 days longer on average than patients in whom SSIs do not develop.<sup>[10]</sup> Furthermore, SSIs may severely affect financial reimbursement. A postoperative complication, such as infection, increased cost of care by over 54% with a resulting profit margin decreased to 3.4%.<sup>[11]</sup> SSIs are the second most common type of adverse event occurring in hospitalized patients, and an estimated 40-60% of these infections are thought to be preventable.<sup>[12]</sup>

Surgical Care Improvement Project identifies three primary antimicrobial performance measures: Appropriate antibiotic selection, administration of antibiotics within 1 h of incision (exceptions are vancomycin and fluoroquinolones), and discontinuation of prophylactic antibiotics within 24 h of surgery end time.<sup>[13]</sup> In 2005, Bratzler *et al.* have reported baseline results from the national surgical infection prevention campaign; the data at that time indicated that surgeons performed reasonably well by selecting an appropriate antibiotic in 92.6% of cases. However, an antimicrobial agent was administered to only 55.7% of patients within 1 h before incision, and antimicrobial prophylaxis was discontinued within 24 h of surgery end time in only 40.7% of patients.<sup>[14]</sup>

Approximately, 80-90% of surgical patients receive some kind of antibiotic prophylaxis, though recent studies have shown that choice of regimen, timing of administration or duration of prophylaxis is inappropriate in approximately 25-50% of cases.<sup>[15-20]</sup> Based on the best available evidence to optimize the patient care and surgeon's practice, the American Society of Health System Pharmacists (ASHP) has developed therapeutic guidelines on antimicrobial prophylaxis in surgery.<sup>[21]</sup> Cefazolin is recommended an agent in the most of the surgical processes for antimicrobial prophylaxis based on ASHP guideline; its recommended dose is 2 g for patient <120 kg and 3 g for ≥120 kg with redosing interval of 4 h.<sup>[21]</sup> Results of a study in Iran showed that the proportion of procedures in which there was compliance with all guideline recommendations (ASHP guideline as a reference) was 0.3%.<sup>[22]</sup>

It seemed there was a major problem in Iran to use antibiotics for surgery site infections prophylaxis everywhere. Also in Boo-Ali Sina hospital antibiotic prophylaxes are not done based on any specific or accepted guideline. This study tried to evaluate the antibiotics administration pattern during a year, in a teaching hospital affiliated with Mazandaran University of Medical Sciences in Sari, Northern of Iran.

## METHODS

This descriptive and retrospective study was approved by the Research Committee of the Mazandaran University of Medical Sciences, Sari, Iran. It was conducted at the general surgery and orthopedic wards in Boo-Ali Sina teaching hospital. The medical records of admitted patients who underwent different surgical procedures were reviewed during May 2010-February 2011, and the relevant information was entered on data collection forms. The data, including patient demographic information, type of surgery, and antibiotic therapy received (agents, doses, dose intervals, routes of administration, number of doses, initiation times, and durations of administration) were collected from the patient's case note. Compliance with the recommendations of the ASHP guidelines<sup>[21]</sup> was assessed for every aspect of antibiotic prophylaxis. Patients who received antibiotics to treat infection were excluded, as were patients for whom it was not possible to determine whether the antibiotic was given as treatment or prophylaxis. All data were coded, and SPSS version 16 (SPSS Inc., Chicago, Illinois, U.S.A) was used for the statistical analysis. The results were presented as mean ± standard deviation and percent (%) where applicable. Continuous variables were compared using student's *t*-test; comparison of qualitative data was performed by Chi-square test. *P* <0.05 was considered to be significant.

## RESULTS

During the period of the months between May 2011 and February 2012, a total of 759 patients who underwent surgery were included in this study. Mean age of patients was 32.02 ± 18.79 years (range 1-90). Hand and foot fractures were the most frequent performed surgery type, accounting for 19.9% and 24.8% of the surgeries, respectively. Table 1 shows the demographic data of the patients and the distribution of the procedures according to surgical specialty.

Procedures for which antibiotics are generally indicated were selected, although ASHP guidelines recommended no prophylaxis for clean operations involving hand, knee, or foot (unless involving implantation of foreign materials). According to the ASHP guideline, antibiotics were indicated in 337 procedures, while antibiotic prophylaxis was provided only in the 22.2% (168 cases) of the procedures. Table 2 shows in 56.4% of the surgeries included in the analysis, the administered prophylactic antibiotics are in accordance with ASHP

**Table 1: Characteristics of the surgical patients received prophylactic antibiotics**

Characteristics	Value (%)
Gender	
Male	542 (71.4)
Female	217 (28.6)
Age (years)	32.02±18.79
Length of hospital stay (days)	5.17±4.45
Surgery types	
Orthopedic surgery	443 (58.4)
General surgery	233 (30.7)
Plastic surgery	83 (10.9)
Surgery class	
Clean (%)	422 (55.6)
Clean contaminated (%)	337 (44.4)

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

**Table 2: Perioperative antimicrobial prophylaxis administered in the study location (n=759)**

Prophylactic antimicrobial	No (%)
Required and administered	87 (11.5)
Not required but administered	81 (10.7)
Required but not administered	250 (32.9)
Not required and not administered	341 (44.9)

guidelines. However, in almost 10% of the surgeries, a prophylactic antimicrobial was given, although it was not required according to the guideline.

The most commonly antibiotic used in the current study was cefazolin (91.7%). Table 3 shows surgical prophylactic antimicrobials used in three distinct wards. The administered antibiotic was appropriate in 104 of 168 evaluated surgical procedures (62%), and gentamicin, metronidazole and ceftriaxone were the most frequently antibiotics used inappropriately. More than 50% of the discordant cases were reported in orthopedic ward.

The mean numbers of prophylactic antibiotic doses were  $6.7 \pm 12.9$  (range 1-36). In 59.8% (100 of 168) evaluated procedures, duration was concordant with the ASHP guideline. In 40.2% (68) procedures, duration was longer than recommended. Mean duration of prophylaxis was  $1.7 \pm 3.2$  days.

In 69 of 168 procedures (41%), the dose was concordant with the ASHP guideline. In 98 procedures (58%), the dose was lower, and in one case was higher than recommended. Lower doses were mainly recorded in general surgery (43%) and orthopedic surgery (41%) wards.

Table 4 shows the frequency of correct prophylactic antibiotic administration in the 337 operations that required a prophylactic antibiotic.

## DISCUSSION

This study reports adherence to ASHP surgical antibiotic prophylaxis guidelines at three surgical wards in a teaching hospital. The results of this practice can help to provide evidence for recommendations that may help to improve health care. Based on the best available evidence to optimize the patient care and surgeon's practice, ASHP had developed therapeutic guidelines on antimicrobial prophylaxis in surgery.<sup>[21]</sup> Although such guidelines have been in place for many years (from 1999), studies showed that inappropriate prophylaxis and poor adherence to guidelines are still major issues.<sup>[23]</sup>

In this study, the compliance rate is significantly higher for clean-surgery as compared to clean contaminated surgery ( $P < 0.05$ ). About 80.8% of clean and 25.8% of the clean contaminated procedures demonstrate compliance with the recommendations. Antimicrobial prophylaxis may be beneficial in clean contaminated procedures; while prophylactic antimicrobials are not indicated for some clean surgical procedures.<sup>[24]</sup> The decision to use prophylaxis depends on the cost of treating and the morbidity associated with infection, compared with the cost and morbidity associated with using prophylaxis.<sup>[21]</sup>

Three parameters of appropriateness of antibiotic prophylaxis such as antimicrobial agent, dose and duration of prophylaxis were evaluated in our study. The ASHP recommends prophylaxis with cefazolin as a single agent for most procedures. Furthermore, in our study cefazolin was the most used antibiotic in preoperative prophylaxis, which is consistent with other studies.<sup>[25,26]</sup> Combination of gentamicin with cefazolin was the second common regimen, while third-generation cephalosporins were reported as the third widely used regiment. However, the use of third generation cephalosporins and aminoglycosides are not recommended for SSI prophylaxis because of less activity against staphylococci infections compared to cefazolin, and excessive use of broad-spectrum antibiotics for prophylaxis increases the risk for resistance, causes more adverse events, and increases health care costs.<sup>[25,27,28]</sup> Also use of vancomycin for antibiotic prophylaxis of surgery was not reported in our study. This may related to not observation of methicillin-resistant *Staphylococcus aureus* (MRSA) colonization or MRSA outbreaks in hospital wards.

One of the inappropriate findings in our study was the prolonged duration of antibiotic prophylaxis, while a single-dose prophylaxis before surgery has been found to be sufficient. Postoperative administration of more than the single dose in clean and clean-contaminated surgeries is unnecessary and leads to development

**Table 3: Antimicrobials used in different wards for surgical prophylaxis (n=168)**

Antibiotic for prophylaxis	Surgery wards			Total	Rate of concordance with ASHP guideline (%)
	Orthopedic	General	Plastic		
Cefazolin	47	38	13	98	58.4
Cefazolin+gentamicin	30	20	4	54	2.4
Ceftriaxone	2	1	3	6	0.6
Ceftazidime	0	1	0	1	0
Metronidazole+ceftriaxone	0	5	0	5	0
Cefazolin+metronidazole	0	2	0	2	0.6
Gentamicin	1	0	0	1	0
Metronidazole+gentamicin	0	1	0	1	0
Total	80	68	20	168	62

Data presented as number of patients received antimicrobial regimen.  
ASHP=American society of health-system pharmacists

**Table 4: Appropriateness of antimicrobial items in surgeries that required prophylaxis (n=337)**

Antimicrobial items	No (%)
Correct choice	87 (26)
Correct choice+correct dose	69 (20)
Correct choice+correct dose+correct duration	46 (14)

of resistant strains.<sup>[29]</sup> Unfortunately in the present study, inappropriate multiple doses (even 36) were administered for some cases. According to ASHP guidelines, minimal duration for antimicrobial coverage includes the time from the incision until the closure of that incision, which is usually covered by single antibiotic dose.<sup>[21]</sup>

It has been demonstrated in some studies that the majority of surgeons tend to extend the duration of antimicrobial prophylaxis longer than the recommended period.<sup>[30-32]</sup> Overall, 101 patients received one or two doses of antibiotic prophylaxis where it was necessary, according to guidelines. Although existing evidence fails to support longer duration of usage of prophylactic antimicrobial agents, inappropriate prolonged administration beyond 24 h is common. Extended prophylaxis has been shown no benefit and is potentially harmful due to the development of drug toxicity, super-infections, and bacterial resistance.<sup>[33,34]</sup> In 2011, a large study of 2373 patients in Tokyo found that the adherence rates for drug selection and treatment duration were 53-84 and 38-68% depending on surgical procedures, respectively.<sup>[35]</sup> In another 3-month period study of surgical hospital in Qatar, the compliance rate of antibiotic selection with the hospital infectious disease guidelines was 68.5%, whereas compliance

rate of antibiotic duration with the hospital guidelines was 40.7%.<sup>[25]</sup> The current study could not analyze the timing of antibiotics administration before surgery, one important element, due to lack of data.

The results of our study continue to document the challenges of disseminating evidence-based knowledge systematically into clinical practice. It is essential for surgeons to be aware of the results of their performance about their adherence to guidelines for antibiotic prophylaxis in order to get improvement. It seems that pharmacists could have a critical role on making aware of surgeons and stuffs, using current guidelines for selection, timing, dosing and duration of antibiotics to improve healthcare quality.

## AUTHORS' CONTRIBUTION

Mohammadreza Rafati had contributed in design and final proofreading, Amirhosein Ahmadi and Omran Habibi had contributed in data collection. Afshin shiva had contributed in data analysis and manuscript preparation.

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