

# Evaluation of the prevalence and Pattern of Antibiotic Prescription for Preventing Infection after General Surgery compared with the standard guidelines

Hassan Talebi Lak<sup>1</sup>, Hemmat Maghsoudi<sup>2</sup>, Sina Zarrintan<sup>3</sup>, Ali Hossein Zeinalzadeh<sup>4\*</sup>

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## Abstract

**Background & Aims:** The use of antibiotics to prevent the infection in the surgical site is fully effective in terms of the principles and standards. The aim of this study was to determine the frequency and pattern of prescribing antibiotics for preventing infection after general surgery in comparison with the standard guidelines.

**Materials & Methods:** In this cross-sectional descriptive-analytic study, information was obtained from 299 of patient records, hospitalized in the general surgical ward of Tabriz Sina Hospital through a checklist. Then, the data were compared with the managed care guideline of the Ministry of Health and Treatment No. 8 (Standard).

**Results:** In this descriptive-analytic cross-sectional study, the most frequently prescribed prophylactic antibiotics during the hospital stay were the combination of (ceftriaxone + metronidazole) 49.1% and cephalosporin 48.4%, and after discharge (cefixime + metronidazole) were 44%, and cephalexin was 41%. Adherence to antibiotic prophylaxis prescription guidelines before surgery was 62.2%, after surgery and before discharge from the hospital was 36.1%, after discharge from the hospital was 66.6% and after surgery, in general, was 27.8%.

**Conclusion:** Considering that the prevalence and pattern of antibiotic prophylaxis use before and after surgery in this study were significantly higher than the global standard, appropriate strategies and measures should be taken to prevent the development of resistant harmful microorganisms and to maintain the efficacy of antibiotics.

**Keywords:** Antibiotic Prescription Pattern, prophylaxis, Prevention of surgical site infection, Standard

**Address:** Department of Community and Family Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

**Tel:** +984133364668

**Email:** zenalali@gmail.com

## Introduction

Infection of the surgical site is one of the most important complications after surgery, which can be

prevented by proper and appropriate antibiotic treatment (1). The use of antibiotics to prevent infection of the surgical site is fully effective, provided that its principles

<sup>1</sup> Department of Community and Family Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

<sup>2</sup> Department of General Surgery, Sina Hospital, Tabriz University of Medical Sciences, Tabriz, Iran

<sup>3</sup> Department of General Surgery, Sina Hospital, Tabriz University of Medical Sciences, Tabriz, Iran

<sup>4\*</sup> Social Determinants of Health Research Center, Associate Professor of Preventive and Community Medicine specialist, Geriatric Medicine Fellowship, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran (Corresponding author)

and rules are fully respected, and this has been proven by various studies (2, 3). When the prophylactic prescription of antibiotics is not based on the correct principles, several complications such as loss of natural microbial flora, increased risk of drug poisoning, more severe infection by resistant bacteria and infections, and unnecessary therapeutic costs will increase (4). Antibiotics are among the drugs that have the most inappropriate prescribing and drug resistance among various drugs. Due to their empirical, and non-standard prescribing, many of the resistant and life-threatening microorganisms have evolved. Research has shown that resistant bacteria can be seen most of the time in areas where antibiotics are more common, such as intensive care units (ICUs) (5, 6). Lack of compliance with the standards of antibiotic use in terms of the types of antibiotic, the amount and their inappropriate dose, the frequency of prescribing, inappropriate methods of administration, and inappropriate time of using resulted in microbial resistance and reduced the effectiveness of antibiotics in the world (7, 8). For the selection of appropriate prophylaxis, various guidelines have been developed. These guidelines help physicians to decide on appropriate antibiotic prophylaxis (9). According to the studies conducted in Isfahan, prescribing antibiotic after hospital discharge following surgery was the least consistent with 49% of standards and the most unwise use, and the type of antibiotic used was only 68% of the time and the correct time to administer antibiotics after surgery was only 56% standard (10). Most studies have shown that 30% to 60% of cases have been incorrect or inappropriate, and these errors are usually documented by the physician or self-treatment (10, 11). Increasingly resistant bacteria and decreasing effectiveness of antibiotics have also inflicted enormous costs on health systems, and since the highest incidence of resistance has occurred in those countries that have consumed the most, the need for new and more effective policies to control the over-consumption of antibiotics throughout

the world is essential (12). Therefore, in our country, in order to control the prescribing of prophylaxis antibiotics before general surgery, the algorithm is executed in accordance with standard No. 8. In this algorithm, there is no need to prescribe antibiotics at the beginning of a clean surgical procedure, such as inguinal hernia and total and partial mastectomy. In all of these cases, the choice of antibiotics is different from the medical practitioner, provided that reasons are given in the patient's case. In the case of cholecystectomy, prophylaxis is not recommended in low-risk patients, and in cases of high-risk patients (age over 60 years, history of previous bile duct surgery, history of acute symptoms or presence of jaundice, inactive gallbladder or gallstone in the bile duct) Ceftriaxone is indicated for up to 3 doses (30 to 45 minutes before surgery and 12 to 24 hours after surgery). In cases of perforation or gangrene, decisions are made based on the clinical status and clinical indication that surgeons make (13, 14). According to a study conducted by Saba Ghaffari et al., in Tabriz in 2016, the use of antibiotics in five hospitals of this city was higher than the global standard and Imam Reza Hospital had the highest antibiotic consumption, and Cefazolin was the most commonly used antibiotic (15, 16). In other parts of the world, various studies have been conducted showing that the use of antibiotics as prophylaxis in surgery is not favorable. In a study by Thomas et al., in 1996, the percentage of compliance with standards in third-level hospitals was 64% (17). In a study conducted by Martelli et al. (2000) in an educational hospital in Italy, 63% of appendectomy and 75% of cholecystectomy had nonstandard antibiotic prophylaxis (18). In an American study by Nemeth et al. in 2010 in an educational hospital, in the post-intervention group, 85% of cases received timely antibiotic prophylaxis (19). Therefore, the present study aimed to determine the rate and pattern of antibiotic prophylaxis after general surgery.

## Materials and Methods

This descriptive-analytic cross-sectional study was performed retrospectively and was conducted based on the information available on patients' files in Sina Hospital in Tabriz in 2017 and in the Department of General Surgery. The study population included patients undergoing surgery of the upper gastrointestinal tract and the small intestine of the lower gastrointestinal tract, the pancreas and the hepato-biliary system, colon resection, acute non-perforated appendectomy, inguinal hernia, and total and partial mastectomy and penetrating abdominal trauma under general anesthesia or spinal anesthesia. Considering the 95% confidence interval and the frequency of non-compliance with the standard which was 50% in Study No. 7, the default was selected and the error value of 0.06 was considered as 299 samples. In this study, the sample selection method was consecutive. The criteria for entering the study are patients who have been recommended for prescribing or not prescribing antibiotics and prescribing patterns for their surgery in the country's national guidelines. The researcher referred to the patients' records and extracted the information and data required and entered into the relevant checklist. The checklist of the researcher included the file number variables, age, gender, cause of hospitalization, type of surgery, preoperative diagnosis, postoperative diagnosis, duration of surgery, smoking or other substance abuse, name, dose and time of Pre-operative antibiotics, name, dose and time of receiving the prescribed antibiotic after the procedure, name, dose, duration and the prescribed antibiotic after discharge was receipt standardized prescribing consistency and completed by patient records. At the end, the consistency of the prescribed antibiotics was evaluated and compared with the standard or national guidelines for managed care (No. 8).

### Entry and exit criteria of the study

General surgical procedures for which there were instructions of prescribing prophylaxis antibiotics were included.

Patients with an immunodeficiency disease, diabetes, a previous infection, positive blood culture, or any evidence of the need to prescribe antibiotics for the treatment or use of antibiotics for any reason other than prophylaxis or prevention were excluded from the study.

### Statistical Analysis

Data were analyzed by SPSS software version 19. Chi-square test was used to investigate the relationship between quantitative variables such as age and compliance of antibiotics prescription with standard. Then, the data were expressed in frequency and percentage of frequency, and the indicators of the central and Scatter, including mean and standard deviation, were calculated.

Kolmogorov–Smirnov test was used for data normalization. Also, to determine the relationship between age, type of surgery, antibiotic dosage, and the number of prescribing antibiotic times with the standards chi-square test was used. The p-value less than 0.05 was considered significant.

## Results

In this descriptive-analytical cross-sectional study, 299 patients who underwent general surgery in Sina Hospital in Tabriz in 2017 were evaluated. The demographic data of the patients included in the study are shown in Table 1. The mean  $\pm$  standard deviation of the patients' age was  $41.22 \pm 16.6$  years. The minimum age was 4 years and the maximum age was 91 years.

**Table 1.** Demographic data of patients.

Variables	Subgroups	frequency	Percentage of frequency
Gender	Male	119	39.8
	Female	180	60.2
Age	0-14	6	2
	15-45	191	63.8
	45-60	59	19.7
	Over 60	43	14.3

The frequency of the type of surgery performed in this study are shown in Table 2.

**Table 2:** Frequency of type of surgery performed in patients under study.

Type of surgery	Frequency	Percentage of frequency
Laparoscopic cholecystectomy	105	35.1
Open cholecystectomy	5	1.7
Resection of the mass of the colon	4	1.3
Colon resection	16	5.4
Gastrectomy	1	0.3
Subtotal gastrectomy	3	1
Gastrojejunostomy	2	0.7
Classical appendectomy	96	32.1
Inguinal herniorrhaphy without mesh	31	10.4
Partial mastectomy	32	10.7
Total mastectomy	1	0.3
Restoration of penetrating abdominal trauma	3	1
Total	299	100

**The Study of the correspondence of frequency and antibiotic prescription pattern with the standard prescription of antibiotics before surgery:**

In the pre-operative antibiotic study, the highest dose (Ceftriaxone + Metronidazole) with doses (1000 and 500 mg) was seen in 139 patients (49.1%) and then Cefazolin 1 g, in 137 patients (48.4%). One patient (0.4%) received Metronidazole 500 mg, 1 patient (0.4%) received Ampicillin 1000 mg, and 5 patients (1.8%) received Cefazolin + Ampicillin (1-1 g). Of the 299 patients, 283 (94.6%) patients received antibiotics before the surgery. Antibiotics were given intravenously before surgery and after surgery (before discharge).

**Prescribing antibiotics after surgery and before discharge:**

The prevalence of Ceftriaxone + Metronidazole in 127 patients (50%) and Cefazolin in 118 patients (46.5%) were the most frequent in the pre-discharge antibiotic study. Ceftriaxone, Metronidazole and Cefazolin + Metronidazole were prescribed for one patient (0.4%). Also, in 5 patients (2%) the prescribed antibiotics were Cefazolin + Ampicillin, and in all of the cases the antibiotics were administered intravenously after surgery. Of 299 patients, 254 patients (84.9%) received antibiotics after surgery and before discharge. Evaluation of the frequency of antibiotic continuation

after surgery showed that the highest frequency was observed within 12 hours after surgery, which was prescribed in 91 patients (37.1%). About 26.9% of patients received antibiotics within 24 hours after surgery, and 1.6%, 2%, and 4.5% received antibiotics for two days, three days, and more than three days, respectively.

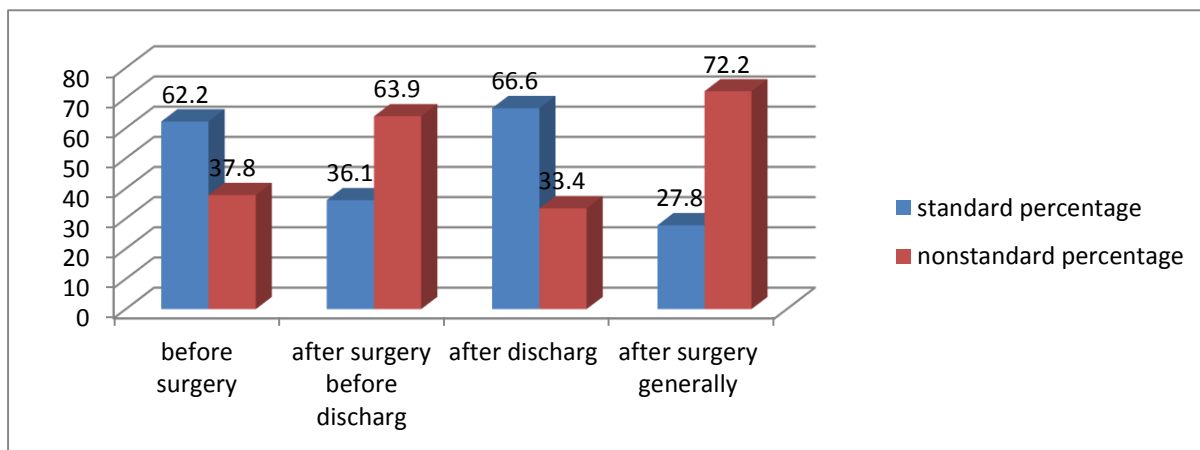
**Frequency and pattern of prescribing of antibiotics after discharge:**

In this study, the highest frequency of prescribed oral antimicrobials after discharge was related to Cefixime +

Metronidazole (Cefixime 400 mg daily and Metronidazole 250 mg every 8 hours and Cephalexin 500 mg every 8 hours). In 100 patient, Oral antibiotic was prescribed, which was not recommended in the standard and 33.4% was non-standard.

Therefore, after discharge the frequency of oral antibiotics, 66.6% of the cases were standard and no antibiotics were prescribed.

The frequency of correspondence with the standard prophylactic prescribing antibiotic in general surgery is shown in Table 3 and Figure 1.



**Figure 1:** The percentage of prescribing prophylactic antibiotics before and after general surgery in comparison with standard guidelines

**Table 3:** Frequency of correspondence with the standard prescribing prophylactic antibiotics in general surgery

Surgery in accordance with Standard No 8, Dept. of Therapy	The number and percentage of subjects treated with standard and correct prophylactic antibiotics					Total number of patients
	Before surgery	After the operation, before discharge	Duration of post-operative prescribing, before discharge	Oral prescription after discharge from hospital	After surgery in general	
Upper gastrointestinal tract, small intestine and pancreatic, hepatobiliary	54 (46.6%)	(51.6%) 60	(45.7%) 53	(75.9%) 88	(41.4%)48	(37.7%) 116
Large intestine resection	(100 %) 20	(85%) 17	7%) 35(	16%)80(	7%)35(	(6.6%) 20
Acute non-perforated appendectomy	(99%)95	(11.5%) 11	(11.5%)11	(45.8%) 44	(9.4%)9	(32.1%) 96

Inguinal Hernia	(6.5%)2	(16.1%)5	(16.1%) 5	(80.6%)25	(16%)5	(10.4%) 31
Total and partial mastectomy	(36.4%) 12	(39.4%) 13	(39.4%)13	(72.7%)24	(39.4%)13	(11%) 33
Penile abdominal trauma	(100%)3	(66.7%) 2	(66.7 %)2	(66.7%)2	(33.3%)1	(1%) 3
Total	(62.2%)186	(36.1%)108	(30.4 %)91	(66.6%)199	(27.8%)83	(100%)299

## Discussion

In our pre-operative antibiotic prophylaxis study, Ceftriaxone + Metronidazole was the most commonly prescribed antibiotic in 139 patients (46.4%) followed by Cefazolin, which was prescribed in 137 patients (45.8%). Also after surgery, Ceftriaxone + Metronidazole were the most commonly prescribed antibiotics in 127 (42.4%) followed by Cefazolin in 118 patients (39.4%). In a 2007 study by Asgarian et al., Cefazolin was prescribed in 97% of the cases (12). In a study conducted by Ebrahimzadeh et al. in Sari Hospital in 2008, the most commonly used antibiotic in the general surgery section was Cephalosporins with a prevalence of 83.1% followed by Metronidazole with a frequency of 36.03% (20). According to the recommendation of the State Standard No. 8, the recommended antibiotics for the purpose of the surgery are Ceftriaxone, Cefazolin, and Metronidazole. Therefore, our study was based on the type of prescribing antibiotic and 98.2% of the prescriptions for cases were according to the guidelines.

In the present study, preoperative antibiotics (Metronidazole and Ceftriaxone) were prescribed with a maximum dose of 500 and 1000 mg in 139 patients (49.1%). Also, 135 patients (47.7%) received 1 g of Cefazolin. The route of administration of antibiotics before the surgery was intravenous in all patients. According to the standard and the current instructions, the dose and type of antibiotics used and the route of administration was in accordance with the instructions and was at the optimum level. In our study, standardization of pre-operative prophylaxis antibiotics was observed in 62.2% of patients under general

surgery. In an intervention study conducted in Brazil in 2006 by De With K et al., prior to the implementation of the prophylaxis with antibiotics, indication of the prescription or non-administration of antibiotics was correct in 56.4% of patients (21). Therefore, the pre-operative prescription of antibiotics was better in our study. In our study, standardization of postoperative antibiotics prescription before discharge was observed in 36.1% and after discharge, it was observed in 66.6% of patients. In a study conducted in Esfahan in 2016 by raeesizade et al., the oral antibiotic prescription after discharge was 49.1% and it had the least matching with standard and in considering the type of antibiotic 68.8% and the duration of prescription was 56.3% standard (7). In our study, the standardization of the time of prescribed antibiotics after the operation and before discharge was observed in 30.4% of patients. In a study conducted by Al-Momanyet in 2009, only 27.9% of doses of antibiotics were prescribed at correct doses and drug prescription intervals were observed only in 13% of patients on the basis of instruction (22, 23). Also, in the study of Shirin Afhami et al. (2012), which was conducted in the surgery department of a university hospital, only 4.6% of the duration of prophylaxis antibiotics was standard prescription(24). In the study conducted in 2006 by I.M. Hoepelman et al., the dose of antibiotics was 20% discordant with the standard and 83% of prophylactic antibiotic prescription was unnecessary (25). These results indicate that after discharge from the hospital, although there is no recommendation to prescribe antibiotics in the standard and in the instructions, it is used in different patients and leads to the development of resistant bacteria. In our

study, in accordance with the standard prescription of antibiotics in surgical operations of the upper gastrointestinal tract and the small intestine, pancreas and hepatobiliary tract before surgery was observed in 46.6% of patients and in general postoperative prophylaxis in 41.4% of patients was standard.

When the duration of the operation is more than 3 hours or a high-risk patient (> 60 years old, history of biliary surgery, history of acute symptoms, jaundice, inactive gallbladder, or gallstone in bile duct) 12 - 24 hours after operation, antibiotic prophylaxis is necessary and no prophylaxis is recommended for uncomplicated Laparoscopic Cholecystectomy (14, 26). However, in our study both preoperative and postoperative antibiotics were prescribed in most patients and were non-standard. In our study in the colon resection surgery use of prophylactic antibiotics before surgery in 100% of patients and after surgery, in general, in 35% of patients was standard. According to the standard, in these cases, after an operation, when the duration of the surgery is more than 3 hours, an additional dose of antibiotics is required (14, 26). But in our study, 65% of patients had also received postoperative prophylaxis which was nonstandard. In acute non-perforated appendectomy surgery, standard preoperative antibiotics were observed in 99% of patients and after surgery, in general, it was observed only in 4.9% of patients. The standard and instructions for postoperative doses are only prescribed when the duration of the surgery is more than 3 hours (14, 26). However, in our study, in appendectomy surgery, postoperative antibiotic prophylaxis was prescribed in 90.6% of patients without indication. In inguinal hernia surgery without mesh, standard post-operative prescription of antibiotics, in general, was observed in 16% of patients. Considering that before and after surgery of inguinal hernia without mesh, no antibiotic prophylaxis was recommended in the guidelines and standards (14, 26).

But in our study, in inguinal hernia surgery, nonstandard antibiotic prophylaxis before surgery was 84% and it was 93.5% after surgery.

Total mastectomy and relative standard pre-operative prescription of antibiotics was observed in 36.4% of patients and postoperative prescription of antibiotics was generally observed in 39.3% of patients. However, none of the prophylaxis antibiotics was recommended in total and partial mastectomy(14, 26). In the surgical procedures of abdominal penetrating trauma, pre-operative standard antibiotic prophylaxis was observed in 100% of patients and it was observed in 33.3% of patients after surgery. However, a small number of patients in this group (only 3 patients) were operated in this hospital during the year 2017 due to penetrating abdominal trauma. According to the standard, only one pre-operative dose of prophylaxis is required unless the length of operation is more than 3 hours, but two of them had a standard antibiotic after surgery. The study conducted by Afhami et al., in 2011, was consistent with the standard prescription of antibiotic in preoperative surgeries rather than after surgery. Also, the patients had a longer follow-up period of non-standard prophylactic antibiotics and duration of prophylaxis was only standard in 14% of cases (24). In our study, the standard of prescription of antibiotics before surgery was in the surgery of the upper gastrointestinal tract, colon resection, acute non-perforated appendectomy, and abdominal penetrating trauma, better than the post-operative; but in inguinal hernia without mesh surgery and total and partial mastectomy, standard of prescribing antibiotic prophylaxis in post-operative cases was better than pre-operative cases. Therefore, it can be concluded that prescribing antibiotics over time is more problematic in hospitals and needs to be corrected.

## Conclusion

These results indicate that pre-operative prophylaxis of antibiotics continues to occur during hospitalization after surgery in this hospital, leading to excessive consumption of antibiotics. Considering that the prevalence and pattern of antibiotic prophylaxis use before and after surgery in this study were significantly higher than the global standard, and appropriate strategies and measures should be taken to prevent the development of resistant harmful microorganisms and to maintain the efficacy of antibiotics.

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