



## Peri-operative antibiotic prophylaxis: Adherence to guidelines and effects of educational intervention

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### ABSTRACT

**Background:** This study was aimed to determine the propriety of perioperative antimicrobial prophylaxis, to evaluate the effects of a training intervention on correction.

**Methods:** This prospective educational intervention study was performed on clean, clean-contaminated, and contaminated wounds in elective procedures. The accuracy of the antimicrobial prophylaxis was analyzed according to international guidelines. The outcome measures were appropriateness of prophylactic antibiotic indication, choice, dose and duration; and cost of inappropriate administration.

**Results:** Before the intervention, 312 procedures were recorded compared with 322 after the intervention. Total compliance rate decreased from 34.3% to 28.5% after the intervention, though insignificantly ( $p = 0.59$ ). Educational training intervention did not change the rate of inappropriate antibiotic choice statistically, and prolonged antibiotic use was significantly higher after the intervention ( $p = 0.01$ ). The positive impact of the intervention was observed in decreased “not indicated but administered” rate ( $p = 0.009$ ) and absence of procedures with “indicated but not administered” and “inappropriate antibiotic dose” which also decreased significantly (both  $p < 0.001$ ). The total cost of irrational antibiotic use was US\$26,230.20.

**Conclusions:** Although this educational intervention study achieved improvements in indications, choice, and dosing of surgical antimicrobial prophylaxis, it failed to improve prolonged use and total compliance rate, and to lower the costs sufficiently. It will probably provide better results by means of compulsory measures for surgeons to comply with available protocols and guidelines, as well as education programs, in order to change the antibiotic utility habits on surgical prophylaxis and to achieve accurate prophylactic administrations.

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### 1. Introduction

Surgical site infections (SSIs) still remain an important problem, despite recent medical and surgical developments. Many placebo-controlled trials have demonstrated that antimicrobial prophylaxis complements meticulous surgical technique in reducing the incidence of wound infection.<sup>1,2</sup> Although surgical prophylaxis principles were determined by means of various guidelines, SSIs have still been the second most common cause of nosocomial infections.<sup>3–8</sup>

Surgical prophylaxis is a short-term antibiotic usage directed to possible agents before, during or immediately after contact.<sup>7</sup> For

optimal prophylaxis, an antibiotic with a targeted spectrum should be administered at sufficiently high concentrations in serum, tissue, and surgical wound during the whole time that the incision is open and at risk of bacterial contamination.<sup>9</sup> A major effect of antibiotic prophylaxis is reduction in the incidence of surgical infections, the number of hospital days, the use of antibiotics for therapeutic purposes, and the sepsis-related mortality rate.<sup>5–8,10</sup>

Inappropriate use of surgical antimicrobial prophylaxis, in terms of prolonged duration and use of broad-spectrum antibiotics, can select for resistant microorganisms and leads to high costs, while incorrect timing reduces its efficacy.<sup>11,12</sup> Many surveillance and intervention studies have been performed on the quality of prophylaxis. National guidelines have been developed to support its correct use. In Turkey, the lack of a national guideline led us to carry out a study to detect the routine surgical practice in our institution about the concordance with the international guidelines, and to arrange and evaluate an educational intervention to adjust inappropriate use.

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The aim of this study was to determine the appropriateness of perioperative antimicrobial prophylaxis and common causes of inappropriate use according to the international guidelines. To improve the quality of surgical prophylaxis, a training intervention was carried out and consequences were compared to pre-intervention practice.

## 2. Materials and methods

### 2.1. Setting

This prospective intervention study, with a before and after design, was performed in a university hospital on all elective procedures. About 2000 surgical procedures are performed in the operating rooms of the hospital each year. These procedures are distributed among the following disciplines: orthopedic surgery, vascular surgery, skin and deep tissue surgery, and endocrine and abdominal surgery including intestinal, gynecologic, and urologic procedures. The main objective was to improve the quality of prophylaxis. The pre-intervention and post-intervention periods were selected through three consecutive months in the winter season of two sequential years when the operating rooms were intensively used.

### 2.2. Data collection

All consecutive procedures with clean, clean-contaminated, and contaminated wounds were recorded. Patients with known allergies to any kind of antibiotics were excluded, since infectious disease specialists consulted these patients before surgical procedures. Data were extracted from medical, anesthetic and nursing records, and medication charts. The following characteristics of patients and procedures were collected: age, gender, wound contamination class, duration of the operation, any kind of implant use, hypotension and/or hypovolemia during the procedure. For patients receiving antibiotics, the choice of the antibiotic, unit doses, number of post-operative doses, time of administration of the first dose and subsequent doses, and time of anesthesia induction and first incision were recorded. The duration of prophylaxis was derived from the number of postoperative doses and the timing of subsequent doses.

### 2.3. Data assessment

Antimicrobial prophylaxis administration was compared with guidelines, and all inappropriate and excessive antibiotic doses were determined for the inappropriately administered quantity. The price of all inappropriately administered antimicrobial agents during the period used was calculated separately as the cost of inappropriate usage in US dollars and then summed up to calculate the total cost of inappropriate administration. All the antibiotics used in the hospital, and thus throughout the study, were obtained from the hospital pharmacy. There are only single choices for every generic agent. Cost analyses were performed considering these agents.

The data were compared with international guidelines, and the accuracy of the antimicrobial prophylaxis management was analyzed according to these guidelines.<sup>3–5,7</sup> Courses of antimicrobial drugs were considered for antibiotic choice, dosage, duration, and timing of prophylaxis. If no antibiotic prescriptions were recorded, it was assumed that antibiotics had not been administered. Criteria for the evaluation of prophylaxis according to guidelines are presented in Table 1. Total compliance was referred to as the sum of “indicated and administered with appropriate choice, dose, and duration” and “not indicated and not administered” procedures.

**Table 1**

Criteria to evaluate the appropriateness of prophylaxis. \*Inappropriate use; \*\*appropriate use.

|                                            |                                                                                                                    |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Not indicated but administered             | Prophylaxis was administered although not indicated*                                                               |
| Indicated but not administered             | Prophylaxis was not administered although indicated*                                                               |
| Indicated and administered and             | Prophylaxis was administered since indicated and                                                                   |
| Choice of antibiotics inappropriate        | Inappropriate antibiotic for efficacy, toxicity, or spectrum*                                                      |
| Inappropriate dose                         | Inappropriate daily dose*                                                                                          |
| Prolonged use                              | Inappropriate length of use after the end of surgery*                                                              |
| Appropriate antibiotic, dose, and duration | Appropriate for choice, dose, and duration**                                                                       |
| Not indicated and not administered         | Prophylaxis was not administered since not indicated**                                                             |
| Total compliance**                         | “Indicated and administered with appropriate choice, dose, and duration” plus “not indicated and not administered” |

Repeated doses were recommended when blood loss during the procedure exceeded 2 L or hypotension was reported, or when surgery was prolonged beyond three times the half-life of the administered antibiotic.<sup>13</sup>

### 2.4. Intervention

The data on inappropriate antimicrobial prophylaxis obtained from the first period of the study were analyzed and transferred to the surgeons and surgery residents in general and branch meetings which involved an education program on antimicrobial prophylaxis. Specific problems in each surgical branch were discussed separately with the surgeons, anesthesiologists, and nurses, together with the local antibiotic policy committee. In addition, educational meetings were organized for all surgeons, residents, and nurses. The first step was a general meeting with all the surgeons and anesthesiologists working in the hospital both as residents and consultants who are junior and senior professionals. First of all, pre-intervention results were presented. The principles of surgical antibiotics prophylaxis and precautions taken during the preparation of the patient before and during surgery to decrease the possibility of surgical infections were reviewed. The stage of inappropriate use of antibiotics such as choice, dosage, duration, and indication of administration, and how good clinical practice should be performed were all explained in this meeting. The appropriate antibiotic choices, doses, and duration were reviewed and related documents were given to the attending surgeons. The specific misuses were also discussed and presented separately to related junior surgeons of different disciplines. Surgeons who could not attend the meeting were involved in extra catch-up work throughout the intervention period. The educational meeting was reinforced by documents involving the guidelines for antimicrobial prophylaxis and posters throughout the hospital. The education program lasted for more than 1 month.

The post-intervention data collection started 1 month after all the intervention activities had ended. The prophylaxis was assessed identically with the pre-intervention period. Finally, data on both periods were compared statistically and the efficacy of training intervention on the use of surgical antimicrobial prophylaxis was investigated.

### 2.5. Statistical analysis

Statistical analysis was performed using Epiinfo version 3.5.1. Student's *t*-test was used to compare continuous variables.

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