

SURVEILLANCE

The intensity of antibiotic usage in the university hospital and the investigation of an inappropriate use of antibiotics

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Abstract: *Aims:* In the present study, we intended to investigate the intensity of antibiotic administration in our hospital and the ratio of an inappropriate antibiotic usage.

Material and method: Related data was collected during 3 consecutive days between 1–3 July 2009 at the Mustafa Kemal University, Faculty of Medicine Hospital. The antimicrobial usage was calculated as defined daily doses (DDDs) per 100 bed-days (BD) according to 2009 ATC-DDD index.

Results: Antibiotics were administered to 74 patients (61.5 %) out of 121 who were hospitalized in our hospital. Antibiotic usage in the internal clinics was intended for therapeutical reasons in 18 patients (94.7 %) and for prophylactic reasons in 35 patients (77.8 %) in the surgical clinics. The use of antibiotics in 44 patients (59.7 %) out of 74 was appropriate. However, an inappropriate antibiotic use was detected in 30 patients (40.5 %). The inappropriate antibiotics were administered to 21 patients (70 %) who were hospitalized in the surgical clinics. A three days total antimicrobial consumption index value in the hospital was 81,19 DDD/100 BD, while this value was found 25,45 DDD/100 BD for the internal clinics and 38,39 DDD/100 BD for the surgical clinics. A positive correlation was observed among the inappropriate antibiotic usage and the antibiotic consumption ($p < 0.001$).

Discussion: Consequently, the ratio of an inappropriate antibiotic usage in our hospital is high and parallel to this, the antibiotic consumption ratio is excessive. It is necessary to share microbiological data and provide an adequate education to reduce the antibiotic consumption and enable a better and rational antibiotic consumption (Tab. 2, Fig. 2, Ref. 22). Full Text in free PDF www.bmj.sk.

Key words: antibiotic, bed-days, drug, hospital, utilization.

As worldwide, antibiotics are frequently used also in our country and are the primary drugs employed in hospitals. Furthermore, inadequate or inappropriate antibiotic usage at a ratio of approximately 50 % is also reported. This type of antibiotic usage may lead to the development of drug-resistant microorganisms, secondary infections and consequently, an increase in healthcare expenses (1, 2). Antibiotic resistance is a very complex event, which does not have a simple solution. Unnecessarily long-term or erroneous administration of antibiotics in hospitalized patients or patients that are monitored in outpatient clinics may result with a selective suppression on drug-resistance and more or less, strains of microorganisms that are resistant to antibiotics may immediately emerge. The antibiotic usage is one of the principal factors necessary to enable the development of microorganisms that are described as, Multiple Drug Resistant microorganisms (3). According to EARSS (The European Antimicrobial Resistance Surveillance System) report, increasing resistance to antibiotics causes difficulties in solutions of the hospital and public health problems (4).

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To conduct an embodiment related with antibiotic usage in hospitals it is necessary to measure antibiotic consumption in an objective aspect. For this purpose, the approach, which is developed and updated at certain intervals by WHO can be employed and this process may provide an opportunity to perform an impartial comparison among units (5, 6). Antibiotic consumption data of the 34 European countries are available in the ESAC (European Surveillance of Antimicrobial Consumption) study (7).

In the present study we compared the ratio of antibiotic consumption and compatibility at the Mustafa Kemal University, Tayfur Ata Sökmen Hospital of Practice and Research.

Materials and methods

The study was carried out at the Mustafa Kemal University, Tayfur Ata Sökmen Faculty of Medicine Research and Training Hospital, a hospital equipped with 136 bed capacity. The hospital contains 7 internal diseases, 7 surgical departments and 1 item of mixed intensive care unit, with the capacity of 11 beds. ATC (Anatomical Therapeutic Chemical) index calculation procedures were not appropriate for the pediatric group of patients and therefore, this group of patients was not enrolled in the study (5, 6).

The study was conducted on 1–3 July 2009 within 3 consecutive days. Patients were visited one by one and their progress status and nursing treatment notebooks were reviewed and when

necessary, a face-to-face interview was arranged with the responsible physician. The dosage of antibiotics administered to each patient was recorded and the total dose amount of antibiotics used in the clinics was also calculated.

Antibiotics are used according to a *limited antibiotic usage policy*, which is compatible with the Health Practice Notification (HPN) enforced by the Ministry of Health. According to this notification, antibiotics such as piperacillin-tazobactam, meropenem, cefoperazone-sulbactam, teicoplanin and tigecycline can be used only after an infection disease specialist (IDS) consent is obtained, while antibiotics such as parenteral ciprofloxacin, levofloxacin, fluconazole or ceftriaxone can be used by an instruction of a related specialist doctor and a IDS consent is necessary during the first 72 hours to continue the use of these groups of antibiotics. However, there is no limitation related with use of antibiotics such as Amikacin, gentamisin, amoxicillin-clavulanate, ampicillin-sulbactam, cephalazoline, cefuroxime, metronidazole and ornidazole.

Unnecessary antibiotic usage; Even though no need is required, antibiotic usage without any findings, which may be doubtful due to signs related to clinical and laboratory findings or infections.

Microbiologically inappropriate antibiotic usage; Even though indication is present to administer antibiotics, unnecessary antibiotic usage due to a condition where a coverage for an active agent in the antibiotic spectrum is absent; when wide spectrum antibiotics are used even though there are no any necessities present or alternatively, administration of reserved antibiotics when a more narrowed spectrum antibiotic is available and practice of an unnecessary combination of treatment.

Pharmacologically inappropriate antibiotic usage; Administration of antibiotics that are inappropriate in dosage and duration and administration of a more toxic agent, even though a less toxic agent is available (multiple side effects).

The administration of the entire antibiotics listed above was considered as inappropriate antibiotics usage.

The “Antibiotic Consumption Index” which is determined by World Health Organization (WHO) can be calculated worldwide by countries/hospitals/clinic, independently from antibiotic unit prices and box sizes and can be compared to the intensities of various antibiotic usages in different environments.

According to this system, the amount of each antibiotic used in the hospital was calculated in grams (oral/parenteral). The daily amount of each antibiotic was calculated according to the Defined Daily Dose (DDD) ratio, which was defined according to the 2009 ATC Index, published by WHO and the DDD was estimated in accordance to the Antibiotic Consumption Index (ACI) after rated to 100 patient bed days (BD) (6).

Statistical analysis was performed by the Chi-square (χ^2) and Pearson Correlation test.

Findings

There was a total number of 121 patients hospitalized during the study, whereas 57 patients (47.1 %) were hospitalized at our internal diseases clinics and 64 patients (52.9 %) were hospitalized at our surgical clinics. The patient’s age varied between 15–

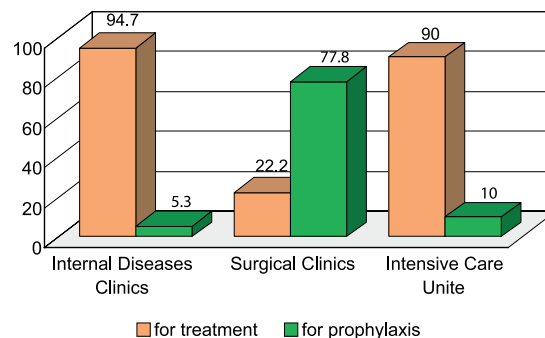


Fig. 1. Antibiotic usage according to indication.

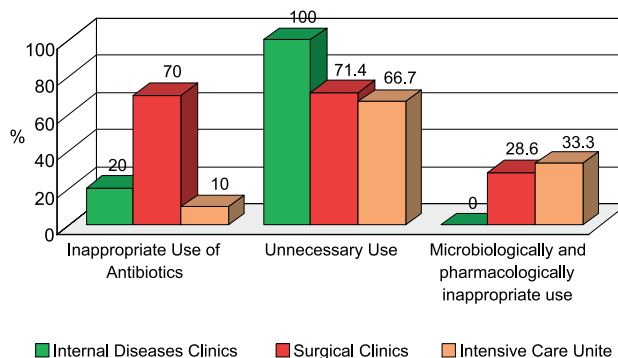


Fig. 2. Inappropriate antibiotic usage according to clinics.

105 and the mean age was 53±20. The antibiotic usage was determined in 74 patients (61.5 %). 33 of the patients (44.6 %) who used antibiotics were females, and 41 patients (55.4 %) were males. 19 patients (25.7 %) were hospitalized at the internal clinics, while 10 patients (60.8 %) were hospitalized at the surgical clinics and 10 patients (13.5 %) were hospitalized in the intensive care units. 8 patients (80 %) in the intensive care unit were patients who were referred from the internal clinics and 2 patients (20 %) were from the surgical clinics.

Nearly 37 patients (50 %) and 37 patients (50 %) were using antibiotics, respectively for the therapeutical and for prophylactic reasons. Approximately 19 patients (94.7 %) in the internal services were using antibiotics for therapeutical reasons while only 1 patient (5.3 %) was using antibiotics for prophylactic reasons. In surgical clinics, 10 patients (22.2 %) and 35 patients (77.8 %) out of 45 were using antibiotics for therapeutical and prophylactic reasons, respectively. However, among 9 patients out of 10 who were hospitalized in the intensive care unit, only 1 patient (10 %) used antibiotics for prophylactic reason. Antibiotic usage was compared between the clinics and it was found that antibiotics were used for therapeutical reasons at the internal clinics and the intensive care units while the ratio of using antibiotics for prophylactic reasons at the surgical clinics was higher (χ^2 :35.499, $p < 0.001$) (Fig. 1).

A number of 44 patients (59.5 %) who used antibiotics were compatible to the descriptions for antibiotic administration. However, inappropriate antibiotic administration was determined in 30 patients (40.5 %). A number of 6 patients (20 %) who were classified as a group of patients with the inappropriate antibiotic

Tab. 1. Hospital Antibiotic Consumption Index (ACI) values and inappropriate antibiotic usage ratios.

Hospital Clinics	ACI	Inappropriate antibiotic usage
Hospital total antibiotic consumption	81.2	30 (40.5%)
Surgical Clinics	38.4	21 (70.0%)
Internal Diseases Clinics	25.4	6 (20.0%)
Intensive Care Unite	17.3	3 (10.0%)
Surgical Clinics		
• Otorhinolaryngology	13.8	5 (16.7%)
• Orthopaedics	8.4	4 (13.3%)
• General surgery	6.4	6 (20.0%)
• Gynecology and Obstetrics	5.3	2 (6.7%)
• Urology	1.9	2 (6.7%)
• Neurosurgery	1.8	3 (10.0%)
• Ophthalmology	0.8	0 (0.0%)
Internal Diseases Clinics		
• Internal Medicine	23.0	6 (20.0%)
• Cardiology	1.7	2 (6.7%)
• Chest Diseases	0.7	0 (0.0%)
• Dermatology	0.0	0 (0.0%)
• Infectious Diseases	0.0	0 (0.0%)
• Physiotherapy and rehabilitation	0.0	0 (0.0%)
• Neurology	0.0	0 (0.0%)

Note: Positive correlation between inappropriate antibiotic usage and antibiotic consumption ($r=0.947$, $p<0.001$)

usage were included at the internal clinics and 21 patients (70 %) were included at the surgical clinics, while 3 patients (10 %) were included in the intensive care unit. The inappropriate antibiotic usage was higher in the surgical clinics and it was found statistically significant that the sub-definitions regarding the inappropriate antibiotic usage was higher in the internal clinics ($\chi^2:6.735$ $p=0,034$) (Fig. 2).

The total number of patient days during the study related to the 121 hospitalized patients was 281. The three days total antibiotic ACI value was found 81.2 DDD/100 BD, while this value was found 25.4 DDD/100 BD in the internal clinics, 38.4 DDD/100 BD in the surgical clinics and 17.3 DDD/100 BD in the intensive care unit. Antibiotic consumption was higher in the Otorhinolaryngology and Orthopaedics Clinics, which are considered as surgical clinics and in the Internal Medicine Clinic, which is considered as an internal clinic.

Once again, it was very interesting to find out that the inappropriate antibiotic usage was more frequently encountered in the Otorhinolaryngology, Orthopaedic and Internal Medicine Clinics, respectively. Additionally, we determined a positive correlation between the inappropriate antibiotic usage and the antibiotic consumption ($r=0.947$, $p<0.001$) (Tab. 1).

When we investigated the antibiotics used in our hospital, we found that ampicillin sulbactam (20.3 DDD/100 BD), cephazoline (14.8 DDD/100 BD) and cephtriaxone (12.5 DDD/100 BD) were antibiotics with high usage ratios. The most frequently used antibiotics in the surgery clinics was cephazoline (13.9 DDD/100 BD) and ampicillin sulbactam in the internal

Tab. 2. Antibiotic Consumption Index (ACI) values of the most frequently administered antibiotics.

*ATC Kod	Antibiotic	Administration route	ACI
Hospital-wide			
J01CR01	Ampicillin and enzyme inhibitor	P	20.3
J01DB04	Cefazolin	P	14.8
J01DD04	Ceftriaxone	P	12.5
Surgical Clinics			
J01DB04	Cefazolin	P	13.9
J01CR01	Ampicillin and enzyme inhibitor	P	7.5
J01DD04	Ceftriaxone	P	4.7
Internal Diseases Clinics			
J01CR01	Ampicillin and enzyme inhibitor	P	12.8
J01DD04	Ceftriaxone	P	5.3
J01MA12	Levofloxacin	P	1.8
Intensive Care Unite			
J01DH02	Meropenem	P	4.0
J02AC01	Fluconazole	P	3.2
J01DD04	Ceftriaxone	P	2.5

*ATC: Anatomical Therapeutic Chemical

clinics, and meropenem (4.0 DDD/100 BD), fluconazole (3.2 DDD/100 BD) and cepthriaxone (2.5 DDD/100 BD) in the intensive care units (Tab. 2).

Discussion

In the modern age, widespread use of antibiotics emerged the opportunity to investigate a solution to avoid the development of resistance. Resistance against antibiotics showed a tendency to increase during the last years and has become one of the major healthcare problems worldwide (3, 8). Nevertheless, the administration of rationale antibiotics to fight against microorganisms is now more important than ever. Rationale antibiotic usage is described as a condition where the most price-convenient antibiotics are used to cover the requirements of the patients in clinic practice, at an appropriate dose and duration (9).

In Turkey, a multi-center pointed prevalence study revealed the fact that approximately, 48.8 % of antibiotics used in hospitals were intended for therapeutical purposes while 44.2 % of the antibiotics were used for prophylactic purposes (10). In our hospital, concordant to the opinion above, the antibiotic usage due to therapeutic and prophylactic reasons was determined as 50 %.

According to some studies, the use of antibiotics at the internal clinics are for therapeutical purposes while the prophylactic antibiotic usage is more frequent in the surgical clinics. During these ongoing studies, the ratios of therapeutical and prophylactic use of antibiotics was found 85.2–97 % and 3–35.5 % for the therapeutical purposes and 3–4.8 % and 64.5–97 % for the prophylactic purposes in the internal and surgical clinics (11, 12). In our hospital, similar to the percentages demonstrated in the

study above, the therapeutical and prophylactic use of antibiotics was calculated as 94.7 % and 22.2 % for the therapeutical purposes and 5.2 % and 77.8 % for the prophylactic purposes in the internal and surgical clinics.

In several studies, the ratio of 40–50 % of an inappropriate antibiotic usage in hospitals was reported (1, 13, 14). In our study, the inappropriate antibiotic usage ratio was similarly high and was found to be 40.5 %.

Usually, the inappropriate antibiotic usage can be described as a condition where antibiotics are administered without any signs of findings that indicate a clinical and laboratory finding or an infection, and may originate due to administration of wide-spectrum antibiotics or antibiotics of inappropriate dose and duration. In Turkey, many studies reported a ratio of 17.4–25.4% and 45.3–63.3 %, of the inappropriate antibiotic usage in the internal and surgical clinics, respectively (11, 12, 14, 15, 16). In our study, we determined the ratio of an inappropriate antibiotic usage in the internal clinics (20 %) and in the surgical clinics (70 %). The ratio of an inappropriate antibiotic usage in the internal clinics was compatible with other studies, but the inappropriate antibiotic usage in surgical clinics was much higher than estimated.

Commonly, for prophylactic purposes it is recommended to administer antibiotics in a single dose or for a period of more than 24 hours (17). After considering these results, we may declare that the awareness state in our hospital regarding the rationale of antibiotic usage is insufficient and that the surgical prophylaxis guidelines are not adequately followed.

The resistance problem that occurred right after patients were exposed to antibiotics, and the heavy financial burden of antibiotics, required a measurement of the usage intensity of such agents and to place a limitation regarding their administration. Parallel to this, measurements and the improvement of antibiotic usage and antibiotic consumption has become the most important subject in many countries and many investigations were carried out and miscellaneous surveillance projects were developed for this purpose (5, 16, 17, 18, 19, 20). Based upon the results obtained from the 2008 ARMED Project, which was initiated in 2003, whereas data from 6 hospitals from Turkey and 25 hospitals from the Southern and Eastern Mediterranean countries were collected, the mean antibiotic consumption ratio was determined as 97.3 DDD/100 BD (80–150 DDD/100 BD) (21). Again, according to several studies, the hospital total antibiotic consumption may vary between 32.02–76.7 DDD/100 BD (16, 18, 19, 22).

In our study, the total antibiotic consumption in our hospital was 81.2 DDD/100 BD.

Antibiotic consumption was extremely high in the surgical clinics. Further more, when compared to the inappropriate antibiotic usage, the antibiotic consumption ratios were higher in clinics where the inappropriate antibiotics usage was excessive (Tab. 1). These circumstances allow us to consider that rational the antibiotic usage may reduce antibiotic consumption in hospitals.

As a result, the inappropriate antibiotic usage ratios are high in our hospital and parallel to this, the antibiotic consumption ratios are also high as expected. Even if a national antibiotic limitation program is applied in our hospital, this may not be

sufficient alone to solve the issue. To reduce the antibiotic consumption in our hospital, we need to share microbiological data with related clinics and implement training facilities for a more rational approach regarding the antibiotic usage.

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