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SURGICAL PERSONNEL' ADHERENCE TO ANTIBIOTIC POLICIES

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SUMMARY

- Objectives. This work aimed at studying the adherence of personnel of the Surgery clinic of our institute to antibiotic policies in place.

- Methods. Antimicrobial resistance surveillance of the alert resistant microorganisms (*Staphylococcus aureus* (MRSA), *Enterobacteriaceae* (ESBL-producing), *Pseudomonas aeruginosa*, MDR); Antibiotic consumption calculation (ABC calc, D. Monnet); Audits of antibiotic prescriptions, and Inquiries – were performed.

- Results. Current antibiotic policies in the Surgery clinic (50-bed) were prepared, discussed and introduced in 2003. Since then, five 3-month audits of antibiotic prescriptions took place. During the last four years (2006-2009), the problem resistant organisms were: MRSA, 10-36 %; ESBL-producing *Enterobacteriaceae*, 14-23 %; MDR *P. aeruginosa*, 30-47 % and carbapenem-resistant, 0-35 %. Antibiotic consumption was between 47.9 and 61.9 DDD/100 bed-day, and first generation cephalosporins were the top used antibiotics (29.5-35.2 DDD/100 bed-day). Two inquiries (2007 and 2009) revealed: - a good compliance with the policies, with the exception of the duration of antibiotic prophylaxis, - and a comprehensive knowledge on antibiotics and antibiotic resistance.

- Conclusion. With one exception (the duration of antibiotic prophylaxis) this study revealed good adherence to antibiotic policies, as well as professional attitudes towards the rational use of antibiotics.

***Key words*:** antibiotic stewardship, surgery, audit, inquiry, Bulgaria.

INTRODUCTION

Nowadays considerations in prescribing antibiotics become more and more important, taking in mind the idea to better cure the patient and to preserve the activity of available antibiotics [6, 7, 9, 11, 13, 21]. In surgery antibiotics are used both as antibiotic therapy of infection and antibiotic prophylaxis (of the surgical site infections). Antibiotic stewardship in a surgical clinic has several elements, related to the instituted antibiotic policies and to the adherence of surgical personnel [1, 4, 14, 18, 19].

The objective of the present work was to study the adherence of personnel of the Surgery clinic to antibiotic policies.

MATERIALS AND METHODS:

- Setting. Medical Institute – Ministry of the Interior is a 350-multiprofile national hospital. Surgery clinic has 50 beds and consists of 3 departments: Abdominal surgery, Thoracic surgery and Septic surgery. During the study period the rate of surgical site infections was between 2.5 % and 3.6 %.

- Antimicrobial resistance surveillance. The surveillance of antibiotic resistance is one of the main tasks of the Clinical Microbiology laboratory. It was based on *in vitro* susceptibility testing of important clinical pathogens by disc diffusion method according to the CLSI, USA - guidelines, 2007.

- Antibiotic consumption. Antibiotic consumption was measured by WHO/ECDC recommended method in DDD/100 bed-day: ABC calc (D. Monnet).

- Audit of antibiotic prescriptions. The audit of antibiotic prescription is one of the most recommended tools in controlling antibiotic policies (ESGAP, ESCMID). Two different forms to be filled in by clinicians were developed: for Antibiotic therapy- and for Antibiotic prophylaxis in Surgery (SAP).

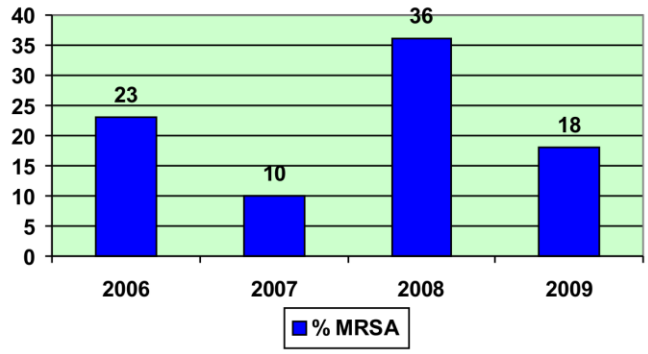
- Inquiry. Two anonymous inquiries were used to study: - the attitudes towards antibiotics and antibiotic resistance and - the instituted antibiotic policies (multiple choice answers – questions were used).

RESULTS

Antimicrobial Resistance surveillance in this work covered the last four years (2006-2009) and focused on the three top-alert microorganisms of clinical significance in surgery: *Staphylococcus aureus*, methicillin – resistant

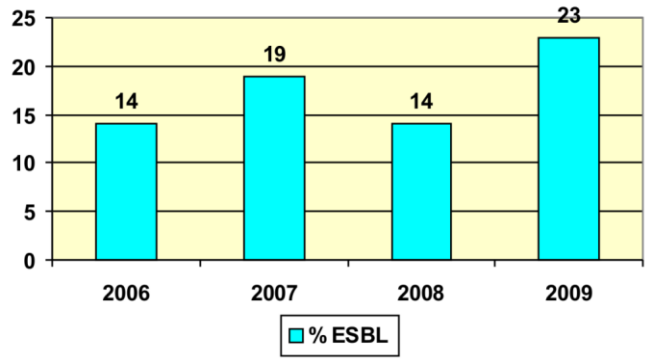
(MRSA); microorganisms of the family *Enterobacteriaceae* – multiple-drug resistant, especially the producers of extended spectrum beta-lactamases (ESBL); multiple-drug resistant (MDR) *Pseudomonas aeruginosa*. Figures 1 – 3 demonstrate the percentage of problem antibiotic resistant organisms in the Surgery clinic during the period from 2006 to 2009:

Fig. 1. Relative rate of MRSA among S. aureus strains (n=139) by year (from 2006 to 2009)



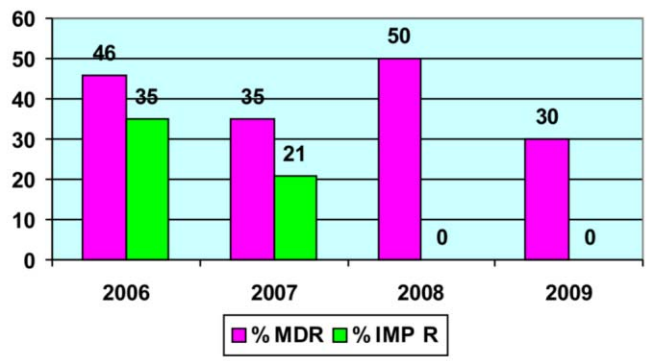
Legend: MRSA, methicillin-resistant *S. aureus*

Fig. 2. Antibiotic Resistance Surveillance – Fam. *Enterobacteriaceae* (n=268)



Legend: ESBL: extended-spectrum beta-lactamase

Fig. 3. Antibiotic Resistance Surveillance – *P. aeruginosa* (n=51)



Legend: MDR, multiple drug resistant; IMP R – resistant to carbapenems

From the figures 1 to 3 it becomes evident, that the percentage of MRSA strains from surgical infections was between 10 % and 36 %, ESBL-producers rate among *Enterobacteriaceae* was between 14 % and 23 %, while the MDR *P. aeruginosa* were from 30 % to 47 %, furthermore, during 2006-2007 several clinical isolates were carbapenem-resistant.

Another important data come from the consumption of antibiotics – Table. 1.

Table 1. Antibiotic consumption in DDD/100 bed-day

Antibiotics	2006	2007	2008	2009
Tetracyclines	0.1	0.1	0.1	0
Penicillins	2.8	5.3	4.7	4.8
Cephalosporins I	32.6	29.9	35.2	29.5
Cephalosporins III	3.3	4.7	3.8	10.0
Cephalosporins IV	0.3	1.3	0	0.5
Macrolides-L-S	0.8	2.1	1.0	2.2
Aminoglycosides	3.2	1.4	0.7	1.8
Fluoroquinolones	1.5	2.1	2.2	4.2
Imidazoles	6.8	4.5	0.1	7.6
Others			0.1	0.2 SXT, 0.3 IMP
Total	50.0	56.4	47.9	61.9

Legend: SXT, co-trimoxazole; IMP, imipenem; L-lincosamides; S-streptogramins

Table 1. shows that the total antibiotic usage in the Surgery clinic fluctuated from 47.9 to 61.9 DDD/100 bed-day. The most commonly used antibiotics were the cephalosporins of first generation, followed by imidazoles: this corresponds to the spectrum of clinic [26].

In an attempt to study the personnel' attitude and adherence to the antibiotic policies, we performed several 3-month audits of antibiotic prescriptions. The first audit was conducted in 2003, before the introduction of current antibiotic policy. The results recorded for Antibiotic prophylaxis in surgery (SAP) – 2003 are listed below:

REGIMEN PRESCRIBED FOR:	EXPERTS' RECOMMENDATIONS
Gastro-duodenal operations- high risk	
Augmentin 3 x 1.2 g (n=4)	
	Cefazolin/Cefoxitin
Ampicillin/Sulbactam 3 x 3 g (1)	
Ceftriaxone 2 x 1 g (2)	
Augmentin 3 x 1 g + *Amikacin* x 1 g (1)	
Cefoperazone 3 x 2 g + *Amikacin* x 1 g (1)	
Cefepime 2 x 1 g + Metronidazole 2 x 1 g (1)	
Biliary tract operations- high risk	
Augmentin 3 x 1.2 g (3)	
	Cefazolin/Cefoxitin
Cefazolin 3 x 2 g (3)	
Ceftriaxone 2 x 1 g (4)	
Cefazolin 3 x 2 g + *Amikacin* x 1 g (1)	
Ceftriaxone 2 x 2 g + Metronidazole 2 x 0.5 g (2)	
Ceftriaxone 2 x 1 g + *Amikacin* x 1 g (1)	
Colo-rectal operations	
Augmentin 3 x 1.2 g (3)	
	PO neomycin + erythromycin , then
Augmentin 3 x 1.2 g + Metronidazole 2 x 0.5 g (2)	IV cefoxitin/cefotetan or
Cefazolin 3 x 2 g + Metronidazole 2 x 0.5 g (5)	
	IV cafazolin + metronidazole
Ceftriaxone 2 x 1 g + Metronidazole 3 x 2 g (1)	
Cefazolin 3 x 2 g + *Amikacin* x 1 g + Metronidazole 3 x 0.5 g (2)	
Augmentin 3 x 1.2 g + *Amikacin* x 1 g + Metronidazole 3 x 0.5 g (5)	
Ceftriaxone 2 x 1 g + *Amikacin* x 1 g + Metronidazole 3 x 0.5 g (1)	

The audit 2003 showed a usage of different antibiotics of wide spectrum, and especially of the cephalosporins of III and IV generation, which are not among the accepted recommendations (and should be reserved for the therapy of infection, when appropriate).

After the audit, a literature search was performed and several world-wide accepted guidelines were reviewed [2, 3, 15, 20, 22, 23]. Surgeons and microbiologists worked together and prepared a model of antibiotic policy in surgery, which was discussed with all colleagues. Written guidelines for surgical antibiotic prophylaxis and therapy were accepted. The control of compliance was performed by four 3-month audits which took place at the end of 2004/beginning 2005, 2006, 2007 and 2008.

Table 2. Summary of audits of antibiotic prescriptions 2004/5, 2006, 2007 and 2008

	2004/2005	2006	2007	2008
Patients	N 66, of them – 32 (19M, 13F, 27-77 year-old (mean 52.7) – received AB prophylaxis	N 9; 7 Male: 21-79 year-old, mean (53.1), 2 Female: 30-49 year old, mean (39.5)	N 25; 10 Female, mean age 64 (28-87); 15 Male, mean age 50.5 (16-77)	N 62; 38 Male, mean age 60.4 (28-85), 24 Female, mean age 60.4 (26-78)
Procedures	18 clean - no AB; 9 preliminary contaminated; 29 clean-contaminated	4 on emergency, 5 elective; 2 clean, with risk factors, 3 clean-contaminated, 2 contaminated, 2 preliminary contaminated	16 elective, 9 emergent; 5 clean, 10 clean-contaminated, 2 contaminated, 8 preliminary contaminated	7 clean, 12 clean-contaminated, 13 contaminated, 30 preliminary contaminated; 42 elective, 20 on emergency

The first most common antibiotic regimen	Cefazolin 3x2.0 IV (n 14)	Cefazolin 3-4 x 2 g I.V.	Cefazolin 3x2g	Cefazolin 3x2g
The second most common antibiotic regimen	± Metronidazole 2-3 x 0.5-1.0 IV/Clindamycin 2x 0.6 IV± Gentamicin 0.160 IV	+ Metronidazole 3x 0.5-1g x 2d±Gentamicin 160 mg I.V	+ Metronidazole 3x500mg	+ Metronidazole 3x500mg ± Gentamicin 160mgAlternatives: : Augmentin, Amikacin, Clindamycin
Positive comments	Adherence to AB prophylaxis guideline	Adherence to AB prophylaxis guideline; the price, availability in hospital pharmacy influence the choice		Choice of antibiotic influenced by: bactericide action, wide spectrum, therapeutic wideness, price, availability in pharmacy
Negative comments	3 patients (9.4 %) needed prophylaxis, but it was not provided	AB prophylaxis continued as therapy: 4-10 days, but with risk factors	Ceftriaxone used in 2; Cefepime - in 1 cases; length of prophylaxis beyond 2 days	Ceftriaxone used to treat *S. aureus* infection; the timing in AB prophylaxis not regularly recorded

In order to focus the surgeons' attention on the accepted antibiotic policy, in 2007 - Antibiotic prophylaxis in surgery (SAP)-inquiry was performed, 19 colleagues participated. Figures 4-6 inform about the percentage of positive replies to three representative questions.

Fig. 4. Surgical antibiotic prophylaxis should be applied:

A. At the beginning of operation; **B**. Up to 30 minutes before the incision; **C.** Up to 60 min before the incision; **D.** Up to 2 hours before the incision

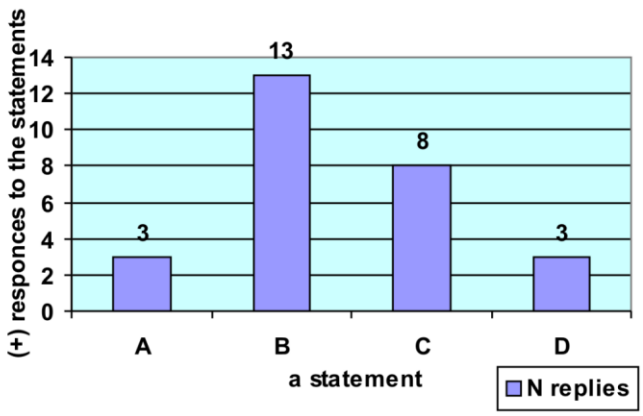


Fig. 5. Surgical antibiotic prophylaxis should continue up to:

A. 24 hours; **B.** 2 days; **C.** 3 days; **D.** 5 days

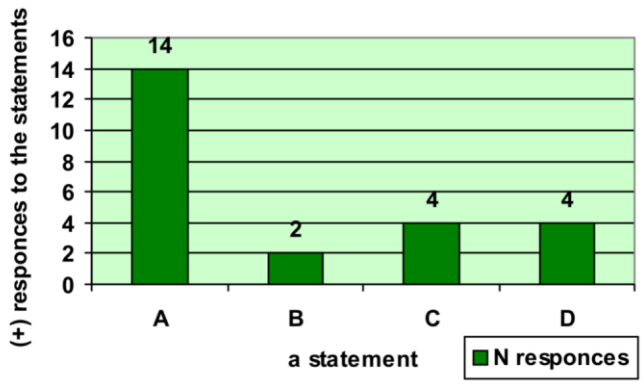
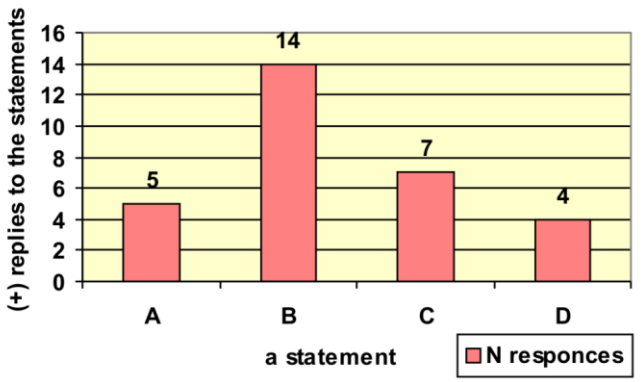


Fig. 6. What kind of operative procedures require antibiotic prophylaxis?

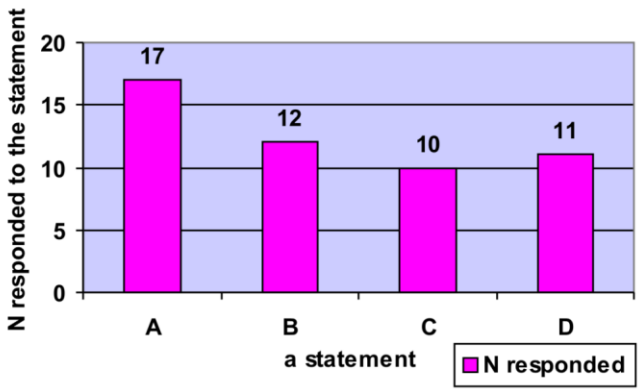
A. Clean; **B.** Clean-contaminated; **C.** Contaminated; **D.** Preliminary contaminated



The results revealed that most of the personnel are well informed, although 4 people answered that the prophylaxis may continue 3 days, and other 4 - 5 days!

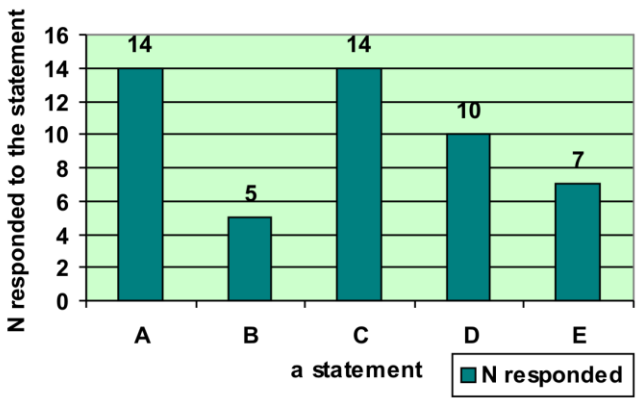
The second Inquiry took place in connection of the 18th November 2009 - which was announced by the WHO and the ECDC as an antibiotic day. Nineteen surgeons participated. The main questions and the corresponding answers are presented in the figures 7 to 11.

Fig. 7. Why antibiotics should be prescribed rationally?



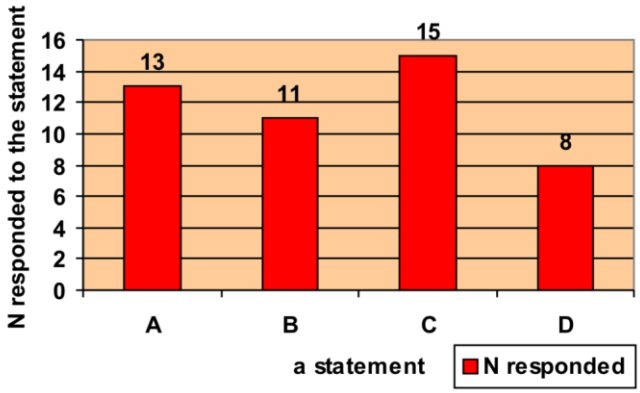
A. Resistance to AB develops and spreads quicklyм **B.** Already there are pan-resistant organisms; **C.** Pharmaceutical industry needs 15-20 years to introduce new AB; **D.** Resistance has social consequences

Fig. 8. What should be considered in antibiotic prescribing?



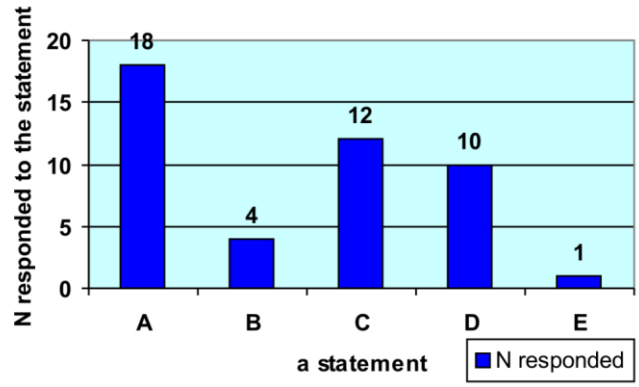
A. Spectrum of activity of the antibiotic; **B.** Mechanism of action; **C.** Effect: bactericidal/ bacteriostatic; **D.** Therapeutic width; **E.** Pk/Pd

Fig. 9. Development of antibiotic resistance is due to:



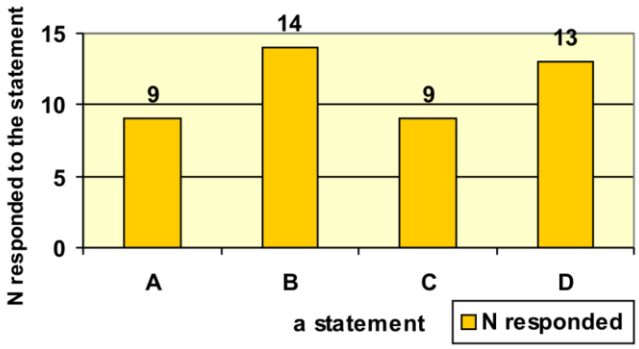
A. Mutations; **B.** Epidemic spread of bacterial plasmids; **C.** Selection of resistant strains by the AB pressure; **D.** Epidemic spread of microorganisms

Fig. 10. Which are the problem antibiotic resistant organisms in our institute?



A. MRSA; **B.** PNSSP (penicillin-non-susceptible *S. pneumoniae*); **C.** ESBL-producing *Enterobacteriaceae* **D.** MDR *P. aeruginosa;* **E.** *Cl. difficile*

Fig. 11. Which are the main measures in the Infection control? (addressed to the nurses)



A. Hand washing; **B.** Good hygiene, disinfection, sterilization; **C.** Contact precautions; **D.** Screening for Antibiotic-Resistant organisms of patients

This inquiry revealed that the personnel of the Surgery clinic is well informed about antimicrobial resistance – related issues.

DISCUSSION

The results of Antimicrobial Resistance Surveillance (Fig. 1-3) identified the problem about antibiotic resistant microorganisms at the Surgery clinic during the last four years as: MRSA (between 10 % and 36 %), ESBL-producing *Enterobacteriaceae* (between 14 % and 23 %) and MDR *P. aeruginosa* (30 % to 47 %). These rates of resistance correspond to the national level [12] and are quite embarrassing, posing problems in therapy of infections.

Antibiotic consumption is another tool in assessing antibiotic policies. It was shown (Table 1) that the total antibiotic usage in the Surgery clinic was from 47.9 to 61.9 DDD/100 bed-day, which, although comparable with similar clinic in the similar geographical/socio-economical area, should be assessed as high. The higher usage of cephalosporins of first generation and imidazoles is related to their usage in therapy and prophylaxis of infections.

The first audit of antibiotic prescriptions, undertaken in 2003, has revealed usage of different antibiotics of wide spectrum, and especially of the cephalosporins of III and IV generation, which are not among the accepted recommendations (and should be perceived for the therapy of infection, when appropriate). On the contrary, the next four audits (Table 2) have clearly demonstrated the complete adherence to the institutionally accepted guidelines. For comparison, in other studies, the rate of inappropriate antibiotic usage in surgery was higher (Hacettepe UH, Turkey, 1994 – 28 %; LDS hospital, Salt Lake City, UT, 1985-1986 – 60 %/ 42 % (timing of prophylaxis); 27-54 % incorrect timing in 2651 patients from 44 hospitals in New York State, USA, 1995; 84 % to 90.5 % of 440 patients in Naples, Italy, 1996, received non-standard antibiotics; in Cornell University, NY, USA, 1998, 156 patients (74 %) of the studied 211, have received inappropriate regimen (excessive duration, incorrect timing, incorrect spectrum or premature switch from I.V. to P.O.; 17 different antibiotics were used for prophylaxis and 21 for therapy) [8]. In their study van Kasteren et al, 2003 [25] found a concordance with accepted policies in Dutch Orthopedic departments 43 % for the dosing interval and 50 % for timing, while the compliance with antibiotic choice, duration and dose was respectively 92 %, 82 % and 89 %. In several more recent articles the authors had similar findings [10, 16, 17, 19, 24]: e.g. Miliani et al [17] in 2009 revealed non-compliance with recommendations generally with the duration of antibiotic regimen (65 %). Most of authors explained non-adherence is due to the fact, that doctors were not aware about the current policies (not informed, not distributed, too many variants etc). In our institute we consider the adherence of surgical personnel is related most probably to the co-authorship in preparing guidelines and the comprehensive discussion before the acceptance.

Although experts recommend interventions as main measures in improving antibiotic policies, we should say, that in our experience we do not achieved all tasks: we wanted to study the reasons for antibiotic choice, but only a few surgeons have filled in this part of the questionnaire: the commonest answers were: because the particular antibiotic was bactericidal, with high therapeutic wideness, of broad spectrum, non-expensive, available in the hospital pharmacy. Also, some of the forms were filled in formally, without the exact timing or dosing regimen, and were not appropriate for evaluation.

CONCLUSIONS

This study showed several important characteristics of the usage of antibiotics in a Surgery clinic.

The problem antibiotic resistant organisms during the period 2006-2009 were MRSA, ESBL-producing *Enterobacteriaceae* and multiple-drug - resistant *P. aeruginosa*, their rate corresponded to the national surveillance rate.

The Antibiotic consumption in the clinic was from 48 to 62 DDD/100 bed-day, which should be evaluated as middle to high. Cephalosporins of first generation were the most applied antibiotics (antibiotic prophylaxis, therapy of staphylococcal infections).

The current antibiotic policy was instituted after a wide discussion in 2003. Four 3-month Antibiotic audits were performed thereafter to control the practice and evaluate the adherence: they revealed a substantial improvement in antibiotic prescribing: cefazolin ± metronidazole were the commonest regimens in abdominal and septic surgery, cephalosporins of higher generation were avoided. Two drawbacks were emphasized: sometimes a higher duration of prophylaxis; the timing in antibiotic application was not recorded in some questionnaires.

One important achievement was the compliance of the surgical personnel with the institutional antibiotic policies, which should be attributed to the co-authorship in guidelines. The positive attitude towards the rational prescription of antibiotics and considerable knowledge on antimicrobial resistance were demonstrated in the two inquiries. In comparison with other studies, the adherence of our personnel to the antibiotic policies in place was higher.

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