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# Prevalence of Healthcare-Associated Infections in Surgical Clinics of the University Clinical Centre of the Republic Of Srpska

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**ABSTRACT**

**Introduction.** Healthcare-associated infections (HAI) are a global public health problem that exists in all health care systems and lead to very significant consequences. All health care systems are obliged to continuously improve preventive measures, which can reduce occurrence of HAI by 10 to 70 percent. First step in improving prevention is constitution of functional epidemiological surveillance over HAI.

**Aim of the study.** The objective of this study was to show, through the point prevalence survey, the rates of HAI in surgical clinics of the University Clinical Centre of the Republic of Srpska (UCC RS), their most important epidemiological characteristics, the most frequently isolated microorganisms and their resistance to antibiotics.

**Material and methods.** In this study, we used standardized methodology for the point prevalence survey of HAI and antimicrobial use, including case definitions established by the European Centre for Disease Control (ECDC). The study was conducted in October 2014 at the surgical clinics of the UCC RS, and it included a total of 196 patients.

**Results.** The prevalence of HAI at the surgical clinics of the UCC RS was 11.7%. The most common localization of HAI were surgical site infections (60.8%). The most common isolated microorganisms were *Acinetobacter* spp., *Enterococcus* spp., *Pseudomonas aeruginosa* i *Staphylococcus aureus*. All isolated *Acinetobacter* and 50% of isolated *Pseudomonas* were resistant to carbapenems, 50% of *Staphylococcus aureus* to methicillin, 50% *Enterococcus* spp. to vancomycin, and 40% *Enterobacteriaceae* to cephalosporins, 3rd generation.

**Conclusion.** The prevalence of HAI at the surgical clinics of the UCC RS is within the frame of the prevalence in developing countries. More attention must be given to this problem. The prevalence study may be the method of choice for HAI surveillance at national level.

**Key words:** prevalence, hospital acquired infections, epidemiological surveillance

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## Introduction

Healthcare-associated infections (HAI) are clinically manifested infections that occur in patients in hospitals or other medical facilities, which have not been present, nor have the patients been in the incubation period at the time of admission. This includes infections acquired in hospitals, but they manifest themselves after a discharge, as well as infections of professional staff in a health institution.<sup>1</sup>

HAI represent a general public health problem that exists in all health care systems, and are accompanied with very significant consequences: they prolong hospital stay, cause frequent hospitalizations, increase morbidity and mortality, they can produce long-term disability, increase of antibiotic resistance, they represent an enormous additional financial burden for the health systems and create high costs for patients and their families.<sup>2</sup> Since HAI endanger the patient's right to safety in a hospital facility, they have a huge ethical significance and are often the subject of lawsuit.<sup>3</sup>

HAI have significant impact on morbidity and mortality in all parts of the world. The frequency of HAI is different in developed and developing countries, but also in individual hospitals and departments. Their prevalence in developed countries is averagely 7.6% (between 3.5% and 12%), while in developing countries the prevalence is in average of 10.2% (from 5.7% to 19.1%).<sup>4</sup>

The prevalence study carried out by the European Centre for Disease Control (ECDC) in 2011 and 2012 in 947 hospitals across the European Union, showed that the average prevalence of HAI is 6.0%.<sup>5</sup> Results from the study that was conducted in 2011 and included 183 patients from several states in the USA showed that 4% of hospitalized patients had had at least one HAI.<sup>6</sup>

Data from developing countries are scarce, given that only about 15% of these countries have a functional system of epidemiological surveillance of HAI. Several studies conducted in health institutions of the countries with limited resources show prevalence rates higher than in developed countries.<sup>7</sup>

Among the clinically important bacteria that commonly cause HAI, multidrug-resistant Gram positive pathogens stand out as follows: methicillin resistant *Staphylococcus aureus* (MRSA) and vancomycin resistant *Enterococcus* spp.(VRE), Gram-negative strains of *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas* spp. and *Acinetobacter baumannii*, which produce extended spectrum  $\beta$ -lactamasas (ES $\beta$ L) and *Clostridium difficile*.<sup>8</sup> Incidence of these infections in hospitalized patients, as well

as mortality and health care costs which they cause, are very high.<sup>8</sup>

In surgical wards, HAI represent a very significant problem, especially in patients with a weakened immune system. Most studies show that the most common HAI in these departments are surgical site infections (SSI). Each SSI extends the hospitalization for additional 7-11 days, while the additional costs depend on the type of operation and the type of infectious agent. Patients with SSI have 2-11 times higher risk of death, compared with surgically treated patients without SSI.<sup>9</sup>

Many HAI are inevitable due to the underlying disease of hospitalized patient, use of invasive diagnostic and therapeutic procedures and potentially pathogenic microorganisms of endogenous flora, which can cause serious infections if the normal defense mechanisms of the patient are weakened.<sup>10</sup> However, many HAI can be prevented. The measures for prevention of occurrence of HAI can be reduced from a minimum of 10% to a maximum of 70%, depending on the type of health facility, the study design, the existing rate of infection and type of infection.<sup>10</sup>

The development of epidemiological surveillance of HAI is the first necessary step toward identifying local issues and priorities and evaluation of effectiveness of measures for infection control. Surveillance is an efficient process of reducing the frequency HAI.<sup>1</sup> Use of standardized definitions is of key importance for reliable surveillance of HAI and represents one of the basic conditions that must be satisfied to be able to compare data at local, national and international level.<sup>7</sup>

## Aim of the study

The objective of this study was to show, via the point prevalence survey, the rates of HAI at the surgical clinics of the University Clinical Centre of the Republic of Srpska (UCC RS), their most important epidemiological characteristics, the most frequently isolated microorganisms and their resistance to antibiotics.

## Material and methods

The study was conducted in October 2014 at the surgical clinics of University Clinical Center of the Republic of Srpska (UCC RS) and included a total of 196 patients. We used a standardized methodology for point prevalence study of HAI, including implementation of the definition of infections, which is used in the European Union and established by the ECDC.<sup>11</sup>

ECDC standard patient-based protocol was used for the data collection. Data were collected through two questionnaires, questionnaire for a health facility (hospital

data) and epidemiological questionnaire (filled for each patient included in the study, infected or not). Epidemiological questionnaire included general information about the patient and data on risk factors (surgery after admission, NHSN or non-NHSN category, McCabe score, invasive procedures: central or peripheral vascular catheter, urinary catheter, intubation).<sup>11</sup>

Information about the infection was collected only if the patient had manifested infections associated with hospitalization, according to the ECDC definition of HAI. According to this definition, HAI are infections which are manifested on the third day of hospital admission or later and meet the case definition on the day of the study. Infections that occur during the first two days of hospitalization may also be considered as HAI, if a patient is discharged from acute care hospitals in the previous 48 hours, or in the previous 28 days if there is *Clostridium difficile* infection, or if there has been a use of relevant invasive procedure before the onset of symptoms. SSI that occurred within 30 days if no implant is left in place, or within one year if implant is in place, is considered as HAI.<sup>11</sup>

According to the protocol, microbiological results that are available on the day of the study are collected. Up to three isolated strains of microorganisms are specified. The sensitivity of the selectable marker of antimicrobial resistance is detected, depending on microorganism. Thus, oxacillin resistance is determined for *Staphylococcus aureus*, glycopeptides for *Enterococcus* spp., cephalosporins, 3rd generation and carbapenems for *Enterobacteriaceae* and carbapenems for *Pseudomonas* spp. and *Acinetobacter* spp.

Multiple sources of data were used for the questionnaire: patients' temperature charts, medical history, microbiol-

ogy and other testing results, understanding the situation of each patient and consultation with appointed doctors. The diagnosis of HAI was concluded by appointed doctor together with the epidemiologist from the data collection team.

This study included all patients hospitalized in surgical clinics UCC RS on the date of the study, all patients who were admitted to the clinic before or at 8 a.m. and were not discharged during the study period. Also, the study included patients who were temporarily absent from the clinic at the time of the study, due to diagnostic or therapeutic procedures in other departments, as well as patients who were discharged for a few hours during the day or over the weekend. The study excluded patients who were admitted for only one day (day care departments, emergency services, dialysis patients, patients admitted to treatment or surgery that ends on the same day).

Data collection in the study was organized in a way that each clinic/department was processed in one day. The study in one hospital was completed in one week.

The collected data were entered in the database that was specially prepared for the study of the prevalence of HAI (HelicsWin.Net) and then they were analyzed using the appropriate statistical methods.

## Results

The study included 196 patients hospitalized at the surgical clinics of UCC RS, who met the parameters for inclusion in the study. Out of the total number of patients, 85 were women (43.4%) and 111 men (56.6%), so that the sex ratio of patients included in the study was 0.77: 1 in favor of men. Most of the patients (52.0%) belonged to the age group 60-79 years (Table 1.).

**Table 1.: Distribution of patients by age and sex**

| Age          | Number of women | Percentage of women | Number of men | Percentage of men | Total | Percentage |
|--------------|-----------------|---------------------|---------------|-------------------|-------|------------|
| 12-23 months | 0               | 0%                  | 2             | 1.8%              | 2     | 1.0%       |
| 2-19 years   | 4               | 4.7%                | 4             | 3.6%              | 8     | 4.1%       |
| 20-39 years  | 4               | 4.7%                | 11            | 9.9%              | 15    | 7.7%       |
| 40-59 years  | 22              | 25.9%               | 28            | 25.2%             | 50    | 25.5%      |
| 60-79 years  | 43              | 50.6%               | 59            | 53.2%             | 102   | 52.0%      |
| ≥80 years    | 12              | 14.1%               | 7             | 6.3%              | 19    | 9.7%       |
| Total        | 85              | 100%                | 111           | 100%              | 196   | 100%       |

The highest percentage of patients was at the Clinic of Abdominal Surgery (20.4%) and the Clinic of Urology (16.3%), Table 2.

**Table 2. Distribution of patients by clinics**

| Klinika                                      | Broj pacijenata |
|--|-----------------|
| Clinic of General and Abdominal Surgery      | 40              |
| Clinic of Urology                            | 32              |
| Clinic of Orthopedic Surgery                 | 22              |
| Clinic of Traumatology                       | 15              |
| Clinic of Vascular Surgery                   | 17              |
| Clinic of Thoracic Surgery                   | 17              |
| Clinic of Pediatric Surgery                  | 7               |
| Clinic of Plastic and Reconstructive Surgery | 12              |
| Clinic for Anesthesiology and Intensive Care | 8               |
| Clinic of Neurosurgery                       | 20              |
| Clinic for Maxillofacial Surgery             | 6               |
| Total  | 196             |

Of the total 196 patients, seven patients (3.6%), according to McCabe score, were classified into the category of patients with rapidly fatal disease (a disease with an expected survival of less than one year). 32 patients (16.3%) had ultimately fatal disease (expected survival under five years), 138 patients (70.4%) non-fatal disease (life expectancy longer than five years), while for 19 patients (9.7%) it was not possible to define McCabe score.

During the current hospitalization, 139 patients (70.9%) were operated: 121 had NHSN surgery (61.7%), while 18 patients (9.2%) had a non-NHSN surgery.

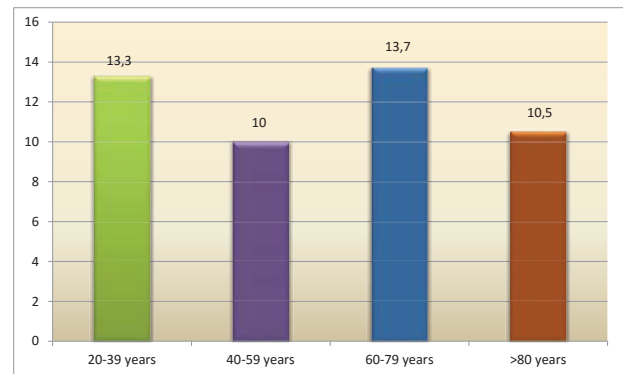
The frequency of relevant invasive procedures in patients during the study was as follows: 158 patients (80.6%) had peripheral vascular catheter, 15 patients (7.7%) had central vascular catheter, 78 patients (39.8%) had urinary catheter, and three patients were intubated (1.5%).

Of 196 patients included in the study, 23 had active HAI, so the prevalence of patients with HAI was 11.7% (95% CI = 7.23 to 16.24), as well as the prevalence of HAI.

From a total of 23 infections, nine were present at admission (39.1%). Eight out of nine infections were acquired in previous hospitalization in the same hospital (88.9%), while one infection had an origin in another hospital.

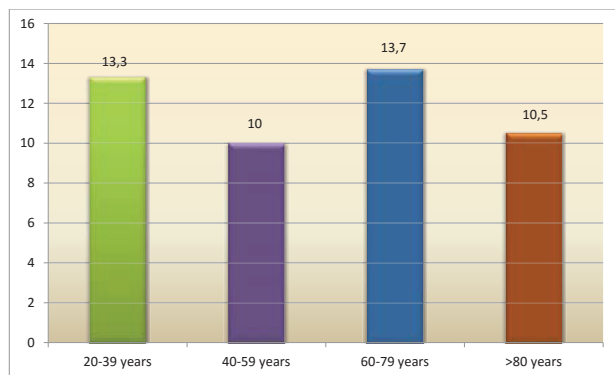
The highest prevalence of HAI was registered in the age group 60-79 years (Figure 1.).

**Figure 1. The prevalence of hospital acquired infections by age groups**



Most patients with HAI were males (69.6%). According to the clinic specialty, the Clinic for Anesthesiology and Intensive Care had the highest prevalence of HAI (37.5%) (Figure 2.).

**Figure 2.** The prevalence of hospital acquired infections by clinic specialty



The most common infections were SSI, which accounted for 60.8% of total registered HAI (15/23). Half of these infections were deep incisional SSI (30.4%). Superficial incisional SSI accounted for 8.7% and SSI with the dissemination on organs/body cavities were 21.7% of all HAI. Pneumonia and infections of the gastrointestinal system were registered in two patients (by 8.7%). Other infections occurred only in one patient each: infections of the central nervous system, cardiovascular infections, bronchitis and urinary tract infections.

From a total of 23 HAI, 11 had microbiological confirmation at the time of the study (47.8%). We identified 15 agents: three agents were isolated in two infections, while it was one agent in others. The most commonly isolated pathogens were *Acinetobacter* spp., *Enterococcus* spp., *Pseudomonas aeruginosa* and *Staphylococcus aureus* (two isolates each, which is 13.3% from the total number of isolated pathogens). By one agent, we detected *Acinetobacter baumannii*, *Clostridium difficile*, *Escherichia coli*, *Klebsiella* spp., *Proteus mirabilis*, *Proteus vulgaris* and *Staphylococcus epidermidis*.

Test for antimicrobial resistance on the day of the study was available for 86.7% (13/15) of isolated pathogens. Methicillin resistance was registered in one out of two isolated *Staphylococcus aureus*, vancomycin resistance in one out of two isolated *Enterococcus* spp., resistance on cephalosporins, 3rd generation in 40.0% of the *Enterobacteriaceae* (2/5), while the carbapenem resistance was observed for all *Acinetobacter* isolates (3) and in one out of two isolated *Pseudomonas*.

## Discussion

Epidemiological surveillance of HAI is the systematic ongoing collection, collation and analysis of data with timely dissemination of information to those who re-

quire this information.<sup>26</sup> WHO recommended prevalence studies in 1981 as a method of choice for understanding the frequency of HAI on national and international level. They are especially recommended for countries with reduced resources, although many developed countries implement national prevalence study annually or every few years.<sup>12</sup>

According to the results of our study, the prevalence of HAI and the prevalence of patients with HAI at the surgical clinics of the UCC RS were 11.7%, which was within the frame of the prevalence in developing countries. Our data showed lower frequency of HAI than data obtained in the prevalence study conducted in 2000, when the prevalence of HAI in surgical clinics of the Clinical Center Banja Luka was 18.4%, while the prevalence of patients with HAI was 16.1%.<sup>13</sup>

The prevalence study conducted in 2011 and 2012 in hospitals across the European Union showed that the average prevalence of patients with HAI in surgical wards was 7%. According to the same study, the prevalence in surgical wards in Slovenia was 6.4% and in Croatia 6.3%.<sup>11</sup> The third national prevalence study of HAI in Serbia, conducted in 2010, showed that the prevalence of patients with HAI in surgical wards was 5.4%.<sup>12</sup>

In our study, the highest prevalence of HAI was observed at the Clinic for Anaesthesiology and Intensive Care, 37.5% (Figure 2). The most frequent occurrence of IHI is expected in intensive care units due to the severity of clinical symptoms and general condition of patients, frequent use of invasive procedures as a risk factor for the occurrence of HAI, etc. The prevalence of HAI in intensive care units in the European Union was 19.5% (19.5% in Croatia, in Slovenia 35.7%),<sup>11</sup> in Serbia 11.6%,<sup>12</sup> while the large international prevalence study, carried out in 2007 in intensive care units in 75 countries, showed that the prevalence of patients with infection was 51%.<sup>13</sup>

The most common type of HAI in our study were SSI (60,8%), with the prevalence of 7,1%, mostly deep incisional SSI and organ/space SSI. This result is consistent with the results of most studies conducted in surgical wards, which show that SSI are the most common complications in surgical patients,<sup>11,12</sup> despite the fact that they belong to a group of HAI that is largely preventable by existing strategies.<sup>13</sup> SSI are the most frequent HAI in low and middle income countries, with an incidence rate of 1.2 to 23.6 per 100 operations. On the contrary, the incidence of SSI in the developed countries varies between 1.2% and 5.2%.<sup>7</sup>

Characteristic result in our study was low prevalence of urinary tract infections (0.5%), unlike most data available from many countries, where urinary tract infections were among the most common HAI.<sup>11,12</sup> Given the fact that, at the time of the study, urinary catheter as a risk factor for urinary infection was in place in nearly 40% of patients, the prevalence of urinary tract infections was probably higher than it was indicated by our results. The reason for the low prevalence of urinary tract infections in our study is the lack of laboratory tests in patients included in the study, which, according to the case definition, are necessary for the diagnosis of urinary tract infections.

These results support the possibility that the overall prevalence of HAI in surgical clinics of the UCC RS is higher than the data obtained in our study suggest.

Some of the European countries that conducted point prevalence study using ECDC protocol, particularly countries with low resources, also reported a lack of necessary laboratory tests for the diagnosis of certain HAI.<sup>11</sup> Low sensitivity (false negative result) is a common problem in national systems of HAI surveillance.<sup>31</sup>

The highest prevalence of HAI in our study was registered in the age group 60-79 years (prevalence 13.7%), followed by the age group 20-39 years (Figure 1.). HAI were significantly more prevalent in men. According to the literature, age over 65 years and male sex were identified as risk factors for the occurrence of HAI.<sup>7,11</sup>

At the time of the study, 47.8% of registered HAI had microbiological confirmation. The most commonly isolated pathogens were *Acinetobacter* spp., *Enterococcus* spp., *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Bacterial agents isolated in our study were the most common in many other studies, except that their order was more or less modified.<sup>11,12</sup>

The test for antimicrobial resistance on the day of the study was available for 86.7% (13/15) of isolated pathogens. Methicillin resistance was registered in one out of two isolated *Staphylococcus aureus*, vancomycin resistance in one out of two isolated *Enterococcus* spp., resistance on cephalosporins, 3rd generation in 40.0% of the *Enterobacteriaceae* (2/5), while the carbapenems resistance was observed for all *Acinetobacter* isolates (3) and in one out of two isolated *Pseudomonas*.

In the European Union, carbapenems resistance was observed in 81.2% of the isolated strains of *Acinetobacter* spp. and in 31.8% of the *Pseudomonas aeruginosa* strains, vancomycin resistance in 10.2% of enterococci,

and methicillin resistance in 41.2% of *Staphylococcus aureus*.<sup>11</sup>

The third national prevalence study of HAI in Serbia showed that 30.3% of the isolated strains of *Acinetobacter* and 24% of the *Pseudomonas aeruginosa* strains were resistant to carbapenems, 51% of the isolated *Staphylococcus aureus* were resistant to methicillin, and 9% *Enterococcus* spp. to vancomycin.<sup>12,13</sup>

Results obtained in our point prevalence study indicate that HAI are one of the leading public health problems to which more attention must be given. The point prevalence study can be the method of choice for the HAI surveillance at national level. Using the ECDC methodology and case definitions would allow comparison of data with other European countries and the comparison between hospitals and in different time periods.

## Conclusion

The prevalence of HAI at the surgical clinics of the UCC RS is within the frame of the prevalence in developing countries. More attention must be given to this problem. The prevalence study may be the method of choice for HAI surveillance at national level.

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## Prevalencija intrahospitalnih infekcija na hirurškim klinikama Univerzitetskog kliničkog centra Republike Srpske

### SAŽETAK

**Uvod.** Intrahospitalne infekcije (IHI) predstavljaju opšti javnozdravstveni problem koji postoji u svim zdravstvenim sistemima i čije su posljedice vrlo značajne. Obaveza svih zdravstvenih sistema je unapređenje preventivnih mjera koje mogu da smanje učestalost ovih infekcija od 10% do 70%, pri čemu ključnu ulogu ima uspostavljanje funkcionalnog epidemiološkog nadzora nad IHI.

**Cilj rada.** Rad ima za cilj da, kroz izvođenje studije prevalencije, pokaže kolika je učestalost IHI na hirurškim klinikama Univerzitetskog kliničkog centra Republike Srpske (UKC RS), koje su njihove najznačajnije epidemiološke karakteristike, koji su najčešći uzročnici te kolika je njihova rezistencija na antibiotike.

**Materijal i metode.** U procesu izrade rada korištena je standardizovana metodologija za izvođenje studije prevalencije IHI, uključujući i primjenu definicija infekcija, koja se koristi u Evropskoj uniji a koju je utvrdio Evropski centar za kontrolu bolesti. Studija je sprovedena u oktobru 2014. godine na hirurškim klinikama UKC RS, a uključeno je ukupno 196 pacijenata.

**Rezultati.** Prevalencija IHI na hirurškim klinikama UKC RS je iznosila 11,7%. Najčešća lokalizacija IHI su infekcije operativnog mjesta (60,8%). Najčešći uzročnici IHI su *Acinetobacterspp.*, *Enterococcuspp.*, *Pseudomonasaeruginosa* i *Staphylococcus aureus*. Rezistencija na karbapeneme je zabilježena kod svih izolovanih sojeva *Acinetobacter* i 50% izolovanih *Pseudomonas*, na meticilin kod 50% *Staphylococcus aureus*, na vankomicin kod 50% izolovanih *Enterococcuspp.*, a na cefalosporine treće generacije kod 40% *Enterobacteriaceae*.

**Zaključak.** Rezultati studije su pokazali da je prevalencija IHI na hirurškim klinikama UKC RS u okvirima prevalencije u zemljama u razvoju. Problemu IHI se mora posvetiti veća pažnja. Studije prevalencije bi mogle da budu metod izbora za nadzor nad IHI na nacionalnom nivou.

**Ključne riječi:** prevalencija, intrahospitalne infekcije, epidemiološki nadzor.