



Nosocomial infections prevalence study in a Serbian university hospital

Studija prevalencije bolničkih infekcija u jednoj univerzitetskoj bolnici u Republici Srbiji

Milena Ilić*, Ljiljana Marković-Denić†

University of Kragujevac, School of Medicine, *Department of Epidemiology, Kragujevac, Serbia; University of Belgrade, School of Medicine, †Institute of Epidemiology, Belgrade Serbia

Abstract

Background/Aim. Nosocomial infections (NI) are a serious health problem resulting in an enormous burden of excess morbidity and mortality rates, and health care costs. The aim of this study was to assess the prevalence of NI and to identify groups of patients at special risk for NI in the University Clinical Center, Kragujevac, Serbia. **Methods.** A period prevalence study design was used in this study. A survey of NI included all patients hospitalized in all departments in the University Clinical Center, Kragujevac. **Results.** Among 764 patients surveyed, the global prevalence rate of patients with at least one NI was 6.2% (95%CI = 5.6–6.8), while the prevalence of NI was 7.1%. The most frequent infections were surgical site infections (14.1%; 95%CI = 12.9–15.3), followed by pneumonia (2.3%; 95%CI = 2.1–2.5) in surgical patients. In medical wards, the most common NI were skin and subcutaneous tissue infections (1.6%; 95%CI = 1.4–1.8), and urinary infections (1.4%; 95%CI = 1.3–1.5). Overall, 85.1% NI were culture-proven; the leading pathogens were *Pseudomonas species* (40.0%), followed by *Staphylococcus species* (25.0%), *Escherichia coli* (22.5%), *Proteus mirabilis* (17.5%) and *Klebsiella-Enterobacter* (12.5%). Multivariate logistic regression analysis identified 3 risk factors independently associated with NI appearance: hospital stay ≥ 8 days ($p = 0.0015$), urinary catheter ($p = 0.0022$) and antibiotic use ($p < 0.001$). **Conclusion.** This study showed that NI are a serious health problem in our hospital. The most common infections were surgical site infections, followed by skin and subcutaneous tissue infection and urinary tract infections. Nosocomial infections were most common in patients in urological and orthopedic departments, and then in intensive care units. Prolonged hospital stay, urinary catheter and antibiotic exposure were risk factors independently associated with NI appearance.

Key words:

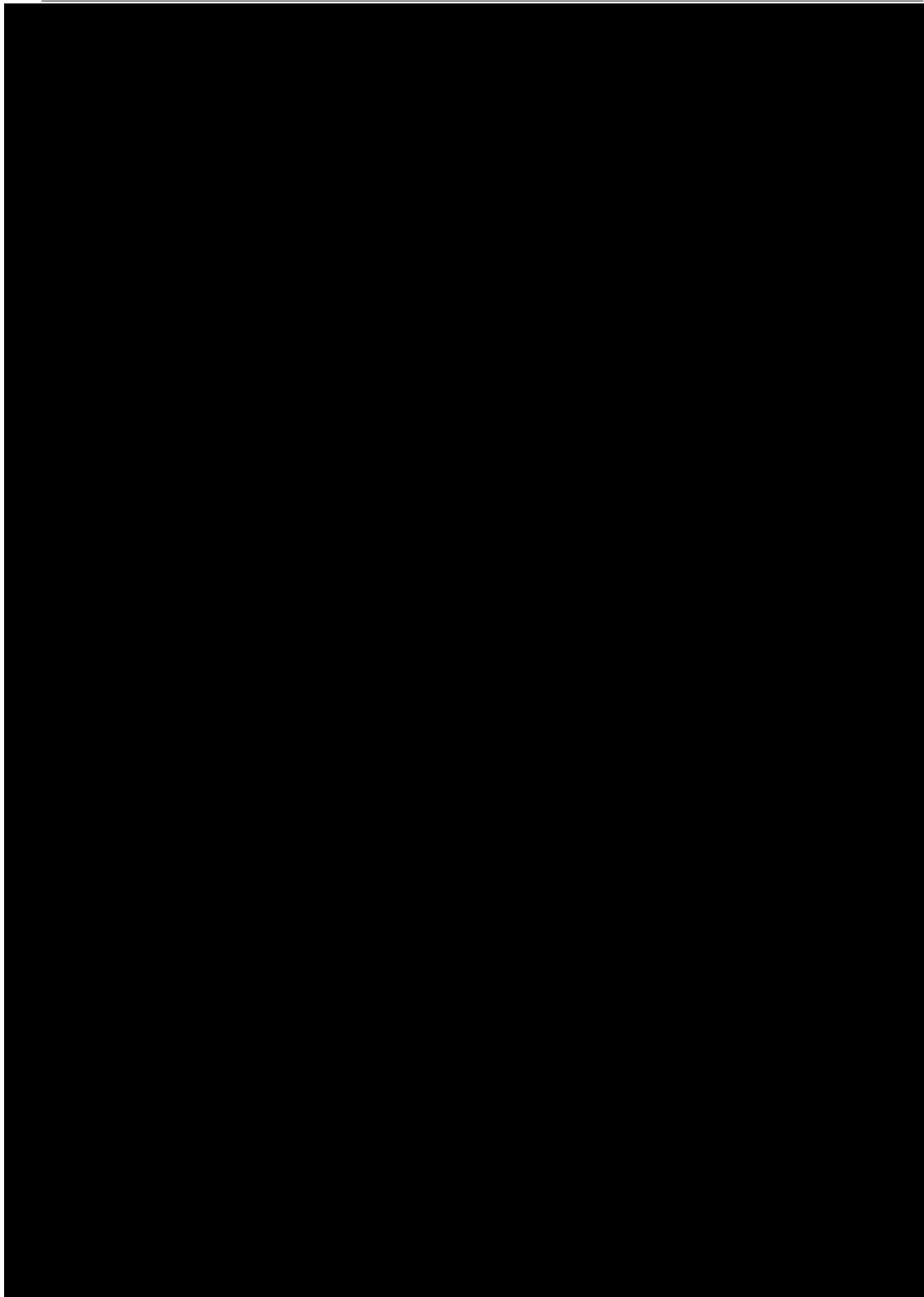
cross infection; yugoslavia; cross sectional studies; risk factors; hospitalization; urinary catheterization; antibacterial agents.

Apstrakt

Uvod/Cilj. Bolničke infekcije (BI) predstavljaju veliki zdravstveni problem koji se manifestuje visokom stopom morbiditeta i mortaliteta i značajnim opterećenjem zdravstvenog budžeta. Ova studija imala je za cilj utvrđivanje prevalencije BI, kao i identifikaciju faktora rizika od nastanka BI. **Metode.** Studija prevalencije BI sprovedena je tokom pet dana u decembru 2003. godine u Kliničkom centru, Kragujevac. Za dijagnozu bolničkih infekcija primenjene su preporuke Centara za prevenciju i kontrolu bolesti (Centers for Disease Control and Prevention, CDC, Atlanta) za definicije BI. U ovom radu prikazane su odabrane varijable koje su uključile karakteristike bolesnika i medicinske prakse (hirurške intervencije, prisustvo vaskularnih i urinarnih katetera, primena antibiotika, trajanje hospitalizacije). U statističkoj obradi podataka primenjen je metod logističke regresione analize. **Rezultati.** Studijom je bilo obuhvaćeno 764 bolesnika, pri čemu je ukupna prevalencija bolesnika sa bar jednom BI bila 6,2% (95%IP = 5,6–6,8). Ukupna prevalencija BI bila je 7,1% (95%IP = 6,4–7,8), sa rangom od 4,9% (95%IP = 4,4–5,4) kod internističkih bolesnika do 18,0% (95%IP = 16,5–19,5) kod hirurških bolesnika. Mikrobiološku potvrdu imalo je 85,1% BI; među prouzročivačima BI najčešće je izolovan *Pseudomonas species* (40,0%), a zatim *Staphylococcus species* (25,0%), *Escherichia coli* (22,5%), *Proteus mirabilis* (17,5%) i *Klebsiella-Enterobacter* (12,5%). Logističkom regresionom analizom identifikovana su tri faktora rizika nezavisno povezana sa pojavom BI: trajanje hospitalizacije ≥ 8 dana ($p = 0,0015$), prisustvo urinarnog katetera ($p = 0,0022$) i upotreba antibiotika ($p < 0,001$). **Zaključak.** Prema ovoj studiji najčešće su bile infekcije operativnog mesta, a zatim infekcije kože i mekih tkiva i infekcije urinarnog trakta. Bolničke infekcije najčešće su zabeležene kod uroloških i ortopedskih bolesnika, kao i kod bolesnika u jedinici intenzivne nege. Duža hospitalizacija, prisustvo urinarnog katetera i primena antibiotika bili su faktori rizika od nastanka BI.

Ključne reči:

infekcija, intrahospitalna; srbija; unakrsno ispitivanje; faktori rizika; hospitalizacija, dužina; kateterizacija urinarnog trakta; antibiotici.



A multivariate stepwise logistic regression model was used to identify variables that were significantly associated with the occurrence of NI, while the effects of other potentially confounding risk factors were simultaneously controlled. This model introduced variables with significant difference or association by univariate analysis. A difference was considered statistically significant for $p < 0.050$.

Results

At the Clinical Center, Kragujevac, 900 patients were hospitalized from 15 to 19 December, 2003. During the investigation, all hospitalized patients were included in the study. A total of 107 patients (11.9%) not at their wards for diagnostic or therapeutic procedures, were not included in the research. Twenty-nine (3.2%) patients were excluded from the study because of the incomplete chart review. Our prevalence study comprised 764 patients (response 84.9%).

Most of the patients (513/764, 67.1%) were under 65 years of age (Table 1). The mean age of the study population

was 49.2 (16.5%), circulatory (15.2%), respiratory (13.4%) digestive (12.4%) and musculoskeletal system (9.6%), as well as the infectious diseases (6.8%). Ninety-two patients (12.0%) had neoplasm. Trauma was recorded in 45 (5.9%). Fewer than 3% were diabetics. Other risk factors for NI (arterial hypertension, chronic respiratory, cardiovascular and renal diseases, presence of other infections, etc.) were recorded in 12.8% of all the patients. There were 50 (6.5%) newborn children and suckpigs. A total of 16.8% (128/764) patients went through a surgery procedure with skin incision. The other invasive procedures frequencies were urinary catheter – 13.5%, peripheral intravenous device – 46.7%. Totally 389 (51.0%) of all the patients received antibiotics at the time of the survey. This included: 278 cases in primary disease therapy, 43 with NI, and 68 patients without any signs of infection. Sixty-two (48.4%) of the patients submitted to surgery had antibiotic prophylaxis.

A total of 6.2% (47/764) of the patients were reported to have nosocomial infections. The overall prevalence of nosocomial infections was 7.1% (54/764), since in 4 patients 11 infections were detected simultaneously.

Table 1

Prevalence of nosocomial infections (NI)* in the Clinical Center, Kragujevac; patients and health care characteristics related

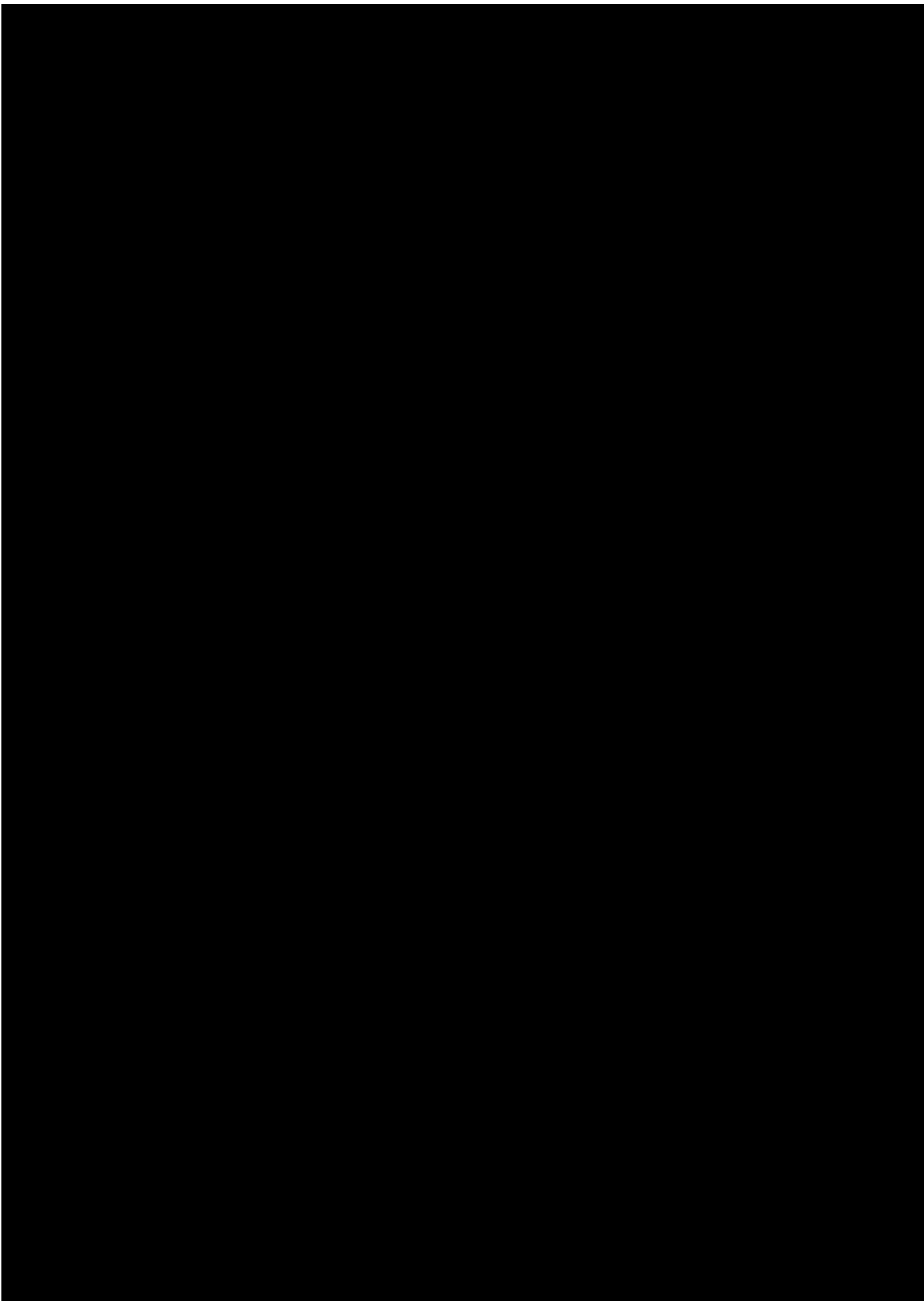
Patients characteristics	Total N (%) of patients	N (%) of patients with NI	p^{\dagger}
Age (years): ≥ 65	251 (32.9)	23 (9.2)	0.038*
Gender			
male	333 (43.6)	22 (6.6)	
female	431 (56.4)	25 (5.8)	0.652
Hospital stay (days): ≥ 8	324 (42.4)	35 (10.8)	< 0.001*
Primary diagnosis group (Diseases of the system)			
circulatory	116 (15.2)	8 (6.9)	
digestive	95 (12.4)	3 (3.2)	
genitourinary	150 (19.6)	6 (4.0)	
respiratory	102 (13.4)	6 (5.9)	
musculoskeletal	73 (9.6)	9 (12.3)	
central nervous	126 (16.5)	6 (4.8)	
infectious diseases	52 (6.8)	3 (5.8)	
new born, suckpigs	50 (6.5)	5 (10)	0.474
Trauma	45 (5.9)	7 (15.6)	0.016*
Neoplasms	92 (12)	3 (3.3)	0.351
Diabetes	23 (3)	3 (13)	0.163
Other comorbidities	98 (12.8)	14 (14.3)	0.001*
Related to health care			
Surgical interventions	128 (16.8)	19 (14.8)	< 0.001*
History of ICU ‡ stay	32 (4.5)	7 (21.9)	0.002*
Intravenous devices	349 (46.7)	35 (10)	< 0.001*
Urinary catheter	101 (13.5)	19 (18.8)	< 0.001*
Antibiotic use	389 (51)	44 (11.3)	< 0.001*

*NI – Nosocomial Infections; $^{\dagger}p$ – probability value (χ^2 test and Fisher's exact test, 2-tailed) indicates statistical significance of the differences in infected and noninfected patients; ‡ ICU – Intensive Care Unit

was 49.2 ± 23.6 years (range 0–89, median 53.0). There were fewer males (43.6%) than females (56.4%). The mean age was 49.3 ± 22.9 years for women (range 0–84, median 53.0), and 49.2 ± 24.5 years for men (range 0–89, median 54.5). More than a half of the patients (440/764, 57.6%) were at the hospital for 8 days or more. The mean of hospitalization length prior to the study was 10.8 ± 15.0 days (range 1–182, median 5.0).

The most frequent disorders on admission were as follows: genitourinary diseases (19.6%), diseases of central nerv-

The prevalence of nosocomial infections was highest in the patients with diseases of the musculoskeletal system, but as compared with other patients the differences were not statistically significant. The surgery patients had more frequently NI than the patients with no surgical procedure ($p < 0.001$). Nosocomial infections were more frequently found in the patients with trauma ($p = 0.016$). The patients admitted to intensive care units showed an even higher prevalence of NI than those admitted to other units ($p = 0.002$). In 10% of the pa-



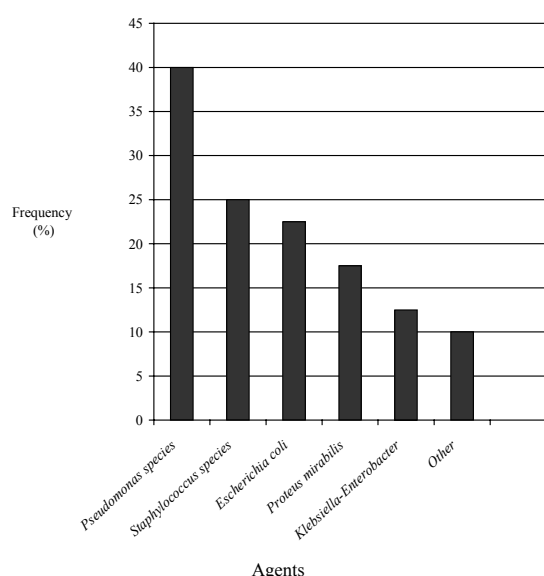


Fig. 2 – Prevalence of nosocomial infections in the Clinical Center, Kragujevac in the function of the isolated microbial agents frequency

According to the results of the univariate logistic regression analysis, age (years ≥ 65), hospital stay (days ≥ 8), trauma, other comorbidities, surgical interventions, history of intensive care unit stay, intravenous devices, urinary catheter and antibiotic use, were statistically significantly linked to NI risks (Table 4). The results of the univariate regression

analysis showed that as compared to noninfected patients, the infected ones were significantly more frequently the elders and longer hospital stay, trauma, other comorbidities, surgical interventions, intravenous devices, urinary catheter, had used antibiotic, or were in intensive care unit.

Multivariate logistic regression analysis identified 3 risk factors independently associated with NI appearance: hospital stay ≥ 8 days ($p = 0.0015$), urinary catheter ($p = 0.002$) and antibiotic use ($p < 0.001$) (Table 5).

Discussion

In our hospital the prevalence of NI was 7.1%. Nosocomial infections were mostly recorded in our youngest and oldest patients. Surgical site infections were most prevalent. At surgical departments, especially in patients with invasive diagnostic-therapeutic procedures (surgery, intravenous devices, urinary catheter), as well as in patients with cancer and trauma and other comorbidities, higher frequency of NI infections was reported. Risk factors independently associated with NI appearance were the duration of hospital stay, urinary catheter and antibiotic use.

The prevalence of NI in this study is within the range reported by investigators from developing countries²³⁻²⁶. However, it is very difficult to compare the prevalence studies and their results in different countries because of different patients' characteristics, different medical experience and, in many cases, different methodology.

Table 4

Results of univariate analysis of potential risk factors for appearance of nosocomial infections

Patient's characteristics	B*	S.E. [†]	p^{\ddagger}
Age (years): ≥ 65	1.4393	0.3431	0.0000*
Gender: male/female	-0.1363	0.3019	0.6517
Hospital stay (days): ≥ 8	0.4393	0.3431	0.0000*
Primary diagnosis group [§]	-0.0201	0.0294	0.4944
Trauma	1.1401	0.4423	0.0100*
Neoplasms	-0.7316	0.6073	0.2284
Diabetes	0.8655	0.6384	0.1752
Other comorbidities	1.2312	0.3490	0.0004*
Related to health care			
Surgical interventions	1.3278	0.3149	0.0000*
History of intensive care unit stay	1.5931	0.4598	0.0005*
Intravenous devices	1.3663	0.3539	0.0001*
Urinary catheter	1.6684	0.3217	0.0000*
Antibiotic use	2.7573	0.6011	0.0000*

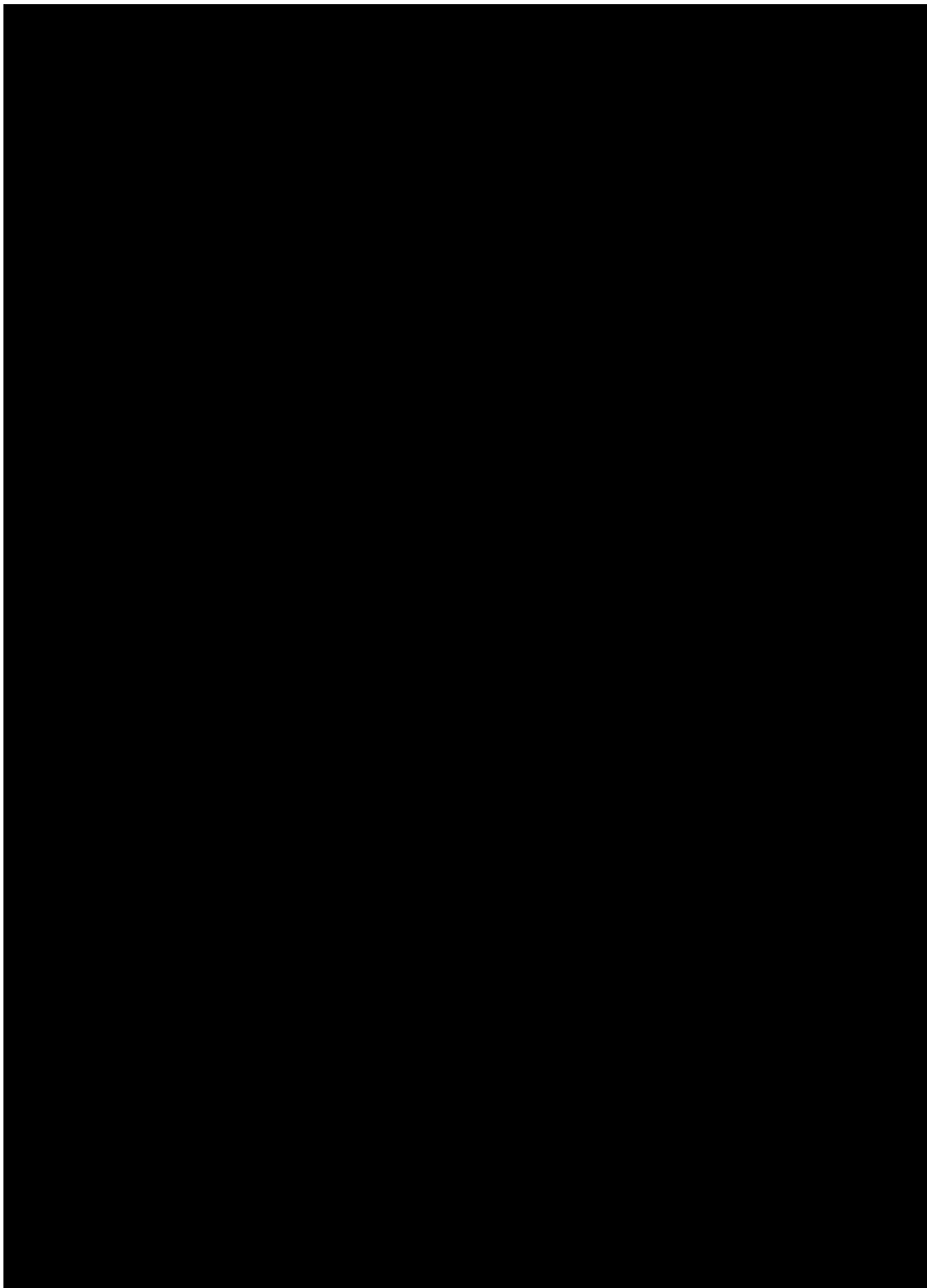
*B – coefficient logistic regression analysis; [†]S.E. – standard error of coefficient logistic regression analysis; [‡] p – probability value according to univariate logistic regression analysis, indicates statistical significance of the differences in infected and noninfected patients; [§]Primary diagnosis group included diseases of the system circulatory, digestive, genitourinary, respiratory, musculoskeletal, and central neural, infectious diseases, and newborn and suckpigs

Table 5

Independent predictors of nosocomial infections: multivariate logistic regression analysis

	B*	S.E. [†]	p^{\ddagger}
Hospital stay (days): ≥ 8	1.2791	0.4032	0.0015
Urinary catheter	1.2817	0.4185	0.0022
Antibiotic use	2.3677	0.6308	0.0002

*B – coefficient logistic regression analysis; [†]S.E. – standard error of coefficient logistic regression analysis; [‡] p – probability value according to univariate logistic regression analysis



well as unreasonable excessive antibiotic use, were associated with raised risk of NI^{35, 36}.

Conclusion

This study shows that NI are a serious health problem in our hospital. The most common infections are surgical site infections, followed by skin and subcutaneous tissue infection and urinary tract infections. Nosocomial infections are most common in urological and orthopedic department, and then in intensive care units. Prolonged hospital stay, urinary

catheter and antibiotic exposure are the risk factors independently associated with NI appearance.

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