HELEN PHAGAVA, MARIAM SANIKIDZE, SOFIKO GURAMISHVILI, IRAKLI MCHEDLISHVILI

FREQUENCY, PREVALENCE AND RISK FACTORS OF NOSOCOMIAL INFECTIONS: THE CASE OF A MULTIDISCIPLINARY HOSPITAL IN TBILISI, GEORGIA

Department of Epidemiology and Biostatistics, Tbilisi State Medical University

Doi: https://doi.org/10.52340/jecm.2026.01.19

ელენე ფაღავა, მარიამ სანიკიძე, სოფიკო გურამიშვილი, ირაკლი მჭედლიშვილი

ნოზოკომიური ინფექციების სიხშირე, გავრცელება და რისკ-ფაქტორები თბილისის ერთ-ერთი მულტიპროფილური საავადმყოფოს მაგალითზე

თბილისის სახელმწიფო სამედიცინო უნივერსიტეტის ეპიდემიოლოგიისა და ბიოსტატისტიკის დეპარტამენტი

რეზიუმე

შესავალი: ნოზოკომიური ინფექციები წარმოადგენს ჯანდაცვის ერთ-ერთ მნიშვნელოვან გამოწვევას, რაც დაკავშირებულია ავადობისა და სიკვდილიანობის ზრდასთან, ჰოსპიტალიზაციის გახანგრძლივებასა და ფინანსურ დანახარჯებთან. საქართველოში მოქმედი ზედამხედველობის რეგულაციების არსებობის მიუხედავად, კლინიკური მონაცემების სიღრმისეული ანალიზი კვლავ შეზღუდულია.

მიზანი: თბილისის ერთ-ერთი მულტიპროფილური საავადმყოფოს მაგალითზე ნოზოკომიური ინფექციების გავრცელების სიხშირის, ძირითადი კლინიკური ფორმების, რისკ-ფაქტორებისა და გამომწვევი მიკროორგანიზმების დადგენა.

მასალა და მეთოდები: ჩატარდა რეტროსპექტული აღწერითი კვლევა 01.01.2023–01.01.2024 პერიოდის განმავლობაში ჰოსპიტალიზებული პაციენტების სამედიცინო დოკუმენტაციისა და ელექტრონული ჩანაწერების გაანალიზების საფუძველზე. შესწავლილ იქნა 2,984 პაციენტის მონაცემები, საიდანაც 2,494 პაციენტი იმყოფებოდა სტაციონარში 48 საათზე მეტხანს და მიეკუთვნებოდა რისკ-ჯგუფს. მონაცემები შეფასდა ჰოსპიტალიზაციის ტიპის, ასაკის, მკურნალობის გამოსავლის, ინვაზიური პროცედურებისა და მიკრობიოლოგიური შედეგების მიხედვით. გამოყენებულ იქნა აღწერითი სტატისტიკური მეთოდები.

შედეგები: დადასტურდა 59 ნოზოკომიური ინფექცია, ინციდენტობა შეადგენდა 2,37%-ს, რაც არ აღემატებოდა საერთაშორისო რეკომენდებულ ზღვრულ მაჩვენებლებს. ლეტალობა შეადგენდა 27,1%-ს. ყველაზე ხშირად გამოვლინდა პნევმონია და საშარდე გზების ინფექცია (33,9% და 33,9%), შემდეგ — სისხლის ნაკადის ინფექცია (22,0%) და ქირურგიული ჩარევის მიდამოს ინფექცია (10,2%). ინფექციების უმრავლესობა დაფიქსირდა გადაუდებლად ჰოსპიტალიზებულ პაციენტებში (88,1%) და 71 წლისა და მეტი ასაკის პაციენტებში (54,2%). ყველა ინფექციასთან ასოცირებული იყო ჰოსპიტალიზაციის გახანგრძლივება და ინვაზიური პროცედურები. ჭარბობდნენ გრამუარყოფითი, მრავალრეზისტენტული პათოგენები, განსაკუთრებით *Klebsiella pneumoniae* და *Acinetobacter baumannii*. მარტში ჩატარებული ხელის ჰიგიენის ტრენინგის შემდეგ აღინიშნა ინფექციების კლების ტენდენცია.

დასკვნა: მიუხედავად ნოზოკომიური ინფექციების დაბალი ინციდენტობისა, მაღალი ლეტალობა მიუთითებს მძიმე, ასაკოვან და გადაუდებლად ჰოსპიტალიზებულ პაციენტთა განსაკუთრებულ მოწყვლადობაზე. აუცილებელია ინფექციის პრევენციისა და კონტროლის ღონისძიებების გაძლიერება, ზედამხედველობის გაუმჯობესება და მაღალი რისკის ჯგუფებზე მიზნობრივი სტრატეგიების დანერგვა.

Background. Nosocomial infections, also referred to as healthcare-associated infections (HAIs), are defined as infections acquired in a hospital setting that manifest at least 48 hours after admission and were neither present nor incubating at the time of healthcare contact [9]. They represent a major global public health challenge in the 21st century, affecting both patients and healthcare systems by increasing length of hospital stay, healthcare costs, and mortality. According to data reported by the World Health Organization [7-9], the prevalence of nosocomial infections ranges from approximately 5% to 15% across countries, with substantially higher rates, exceeding 40%, reported in intensive and critical care units.

Data from the Centers for Disease Control and Prevention [4] indicate that even in high-income countries at least one in 31 hospitalized patients acquires a healthcare-associated infection, underscoring the considerable burden of these infections worldwide. Beyond their impact on morbidity and mortality, nosocomial infections impose significant financial strain on healthcare institutions and national health systems and adversely affect the quality of medical care [2].

In Georgia, systematic surveillance of nosocomial infections was formally introduced in 2015 through regulations issued by the Ministry of Labour, Health and Social Affairs of Georgia (2015), mandating registration, monitoring, prevention, and control of healthcare-associated infections across all medical facilities [5]. Nevertheless, nosocomial infections remain a persistent challenge in the country, partly due to underreporting and misclassification at the facility level, which limits accurate epidemiological assessment and the development of effective prevention strategies. The growing problem of antimicrobial resistance, closely linked to nosocomial infections and frequently driven by inappropriate antibiotic use, further increases the relevance of this issue, as emphasized by the World Health Organization (2014) and the European Centre for Disease Prevention and Control [3].

Goal. This study aims to determine the prevalence, the most common clinical forms, risk factors and causative microorganisms of nosocomial infections.

Materials and Methods. The study was conducted in a multidisciplinary hospital in Tbilisi and involved the review of medical documentation of patients diagnosed with nosocomial infections during the period 01/01/2023–01/01/2024. Within the study framework, medical records and electronic data of 2,984 hospitalized patients were retrospectively analyzed, of which 59 cases were confirmed as nosocomial infections (Pneumonia - 20 patients, Urinary tract infections - 20 patients, Surgical site infections - 6 patients, Bloodstream infections - 13 patients).

Descriptive statistical analysis of the collected data was performed. The results are presented in the form of tables and graphs. Data processing was carried out using Microsoft Excel. The study was conducted in compliance with patient data confidentiality and privacy protection principles.

Results.

Distribution of Nosocomial Infections by Month and Type of Hospitalization.

According to data from the medical institution for the period 01/01/2023–01/01/2024, a total of 2,984 inpatients were admitted. Of these, 2,494 patients remained hospitalized for more than 48 hours, including 1,647 emergency admissions and 847 elective admissions. Among the 2,494 patients hospitalized for more than 48 hours, 59 cases of nosocomial infection were diagnosed, of which 16 patients died. The incidence rate, calculated for the at-risk population, was 2.37% (59/2,494), while the case fatality rate among patients with nosocomial infections was 27.1% (16/59).

A total of 59 nosocomial infections were identified in the clinic - 20 were classified as pneumonia, 20 as urinary tract infections, 6 as surgical site infections, and 13 as bloodstream infections (see Figure 1.). The monthly distribution of these infections is presented in Figure 2.

As noted above, the number of patients admitted on an emergency basis during the study period was 1,647. Notably, of the 59 recorded nosocomial infections, 52 cases (88.14%) occurred among patients who received emergency inpatient care. It is important to illustrate the epidemiological dynamics among emergency-admitted patients using key epidemiological indicators. The data were analyzed based on two main indicators: incidence (disease burden) - expressed as the monthly proportion of infectious complications among patients hospitalized on an emergency basis - and the case fatality rate among patients with infectious complications. Notably, of the 16 deaths recorded, 13 occurred among patients who had received emergency inpatient care (see Figure 3).

Figure 1. Distribution of nosocomical infections by site (%)

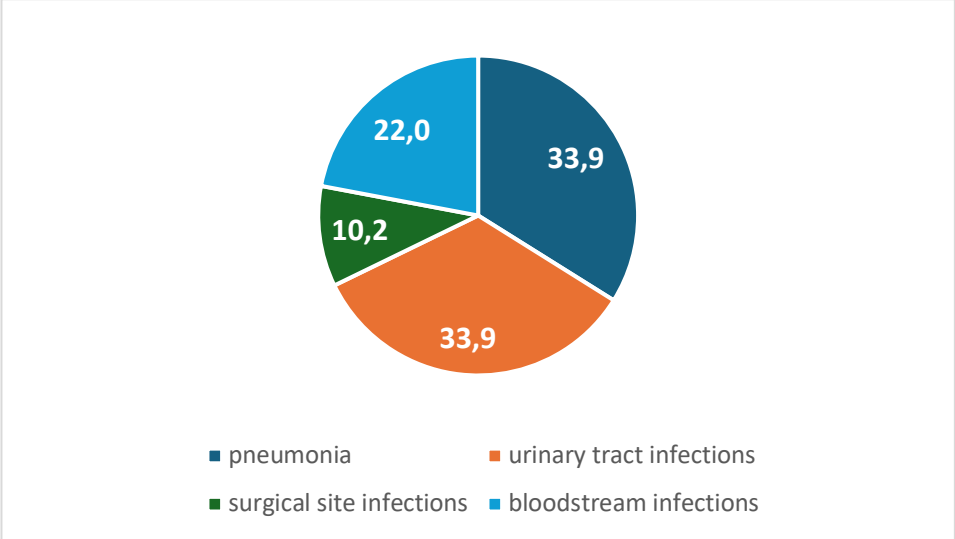


Figure 2. Monthly distribution of nosocomial infections by site

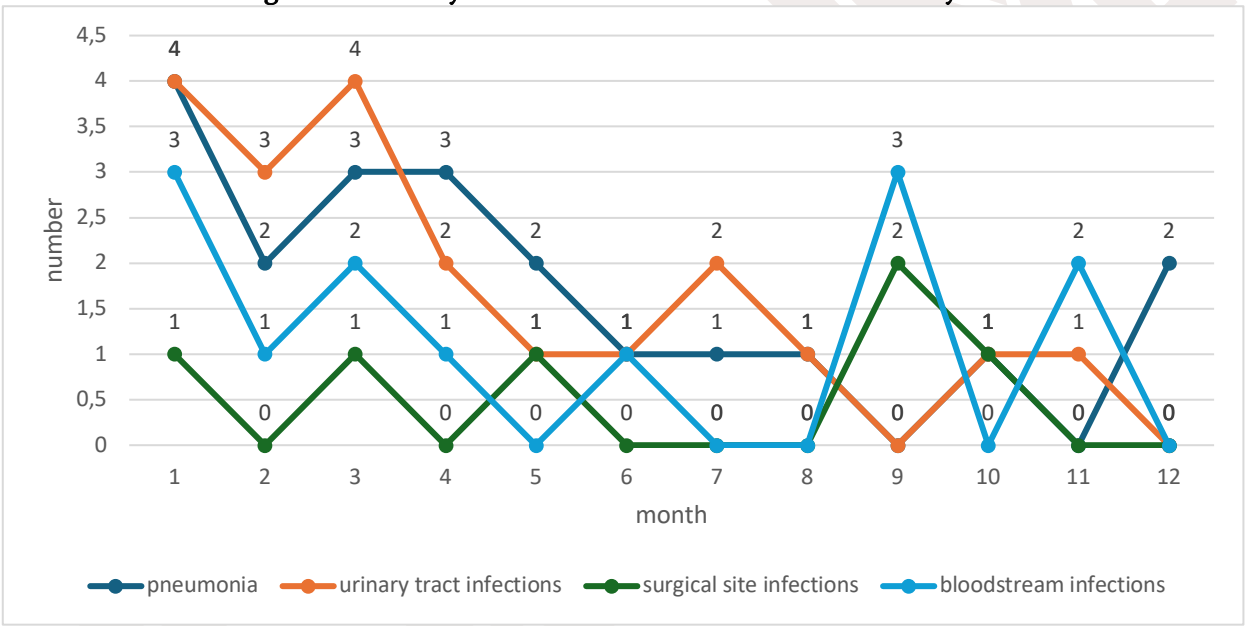
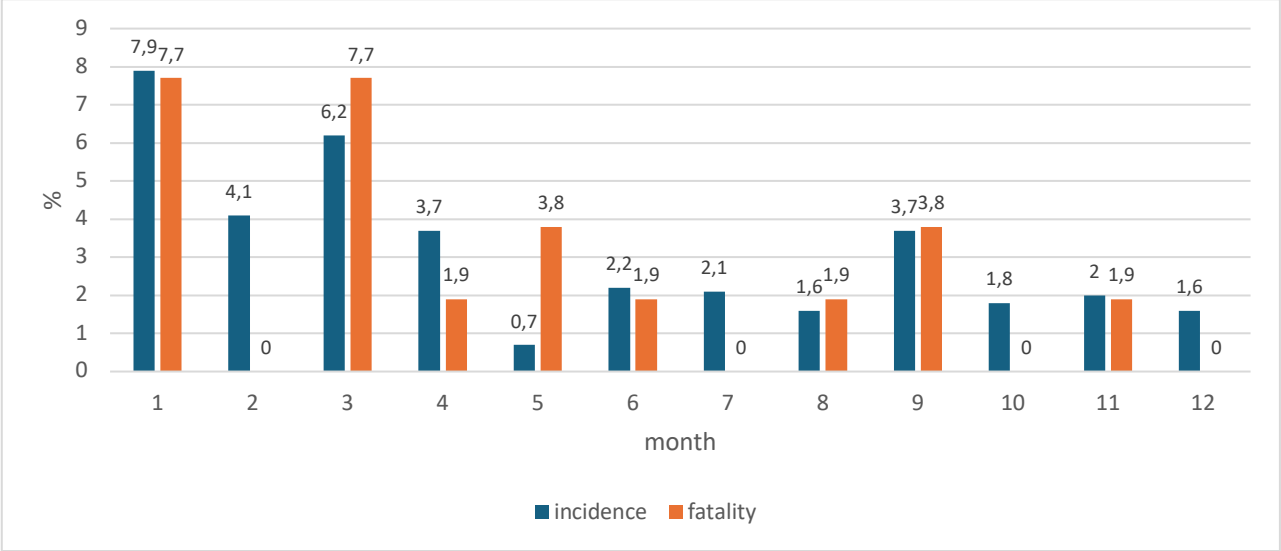


Figure 3. Dynamics of epidemiological indicators among emergency patients (%)



The proportion of infectious complications among electively admitted inpatients was 11.9%, indicating that only 7 out of the 59 infectious complications were associated with elective medical care. The monthly dynamics of epidemiological indicators among electively admitted patients show that infectious complications were largely absent throughout most of the year. Incidence was observed only in a limited number of months, with a noticeable increase in March and a pronounced peak in May, where the incidence reached its highest value. Correspondingly, the case fatality rate was non-zero only during these months, reaching its maximum in May. In the remaining months, both incidence and case fatality rates were zero, indicating no documented infectious complications among electively hospitalized patients during those periods. Overall, the findings demonstrate that nosocomial infections in elective admissions were sporadic and temporally clustered, with no sustained monthly trend.

Risk Factors for Nosocomial Infections.

As shown in Table 1, the number of patients infected with nosocomial infections increases with age, while the proportion of favorable outcomes decreases. According to the grouped data, 54.2% of nosocomial infections were confirmed in patients aged 71 years and older, whereas only 8.5% occurred in patients aged 51 years or younger, indicating that the risk of developing nosocomial infections increases with advancing age. Notably, none of the hospitalized patients aged 0–51 years had a fatal outcome. In addition, the table demonstrates that 75% of patients with nosocomial pneumonia belonged to the ≥71-year age group.

Table 1. Distribution of Nosocomial Infections by Patient Age and Association With Treatment Outcomes

age	pneumonia	urinary tract infections	surgical site infections	bloodstream infections	total	%	treatment outcome	stabilization	restoration of vital functions	death
0-50	0	1	2	2	5	8.5		5 (100%)		
51-70	5	4	9	4	22	37.3		14 (64%)	1 (4%)	7 (32%)
>70	15	1	9	7	32	54.2		15 (47%)	8 (25%)	9 (28%)

Pneumonia. All 20 patients (100%) experienced prolonged hospitalization, indicating that extended length of stay was a universal characteristic among affected individuals. Mechanical ventilation was required in 18 patients (90%), highlighting its strong association with the development of nosocomial pneumonia. Chronic comorbid conditions, including diabetes mellitus and cardiovascular or pulmonary diseases, were present in 7 patients (35%). In addition, chronic obstructive pulmonary disease (COPD) was identified in 4 patients (20%).

Overall, the findings demonstrate that prolonged hospitalization and mechanical ventilation were the most prevalent risk factors, while chronic comorbidities and COPD contributed to the risk in a smaller, yet clinically relevant, proportion of patients.

Urinary tract infections. All 20 patients (100%) underwent urinary bladder catheterization, indicating that catheter use was present in every case of nosocomial urinary tract infection. Prolonged hospitalization was observed in 12 patients (60%), suggesting a substantial association between extended length of stay and infection development. In addition, urinary retention was documented in all 20 patients (100%), identifying it as a universal contributing factor in this patient group.

Overall, the findings indicate that urinary retention and catheterization were constant risk factors, while prolonged hospitalization affected more than half of the patients.

Surgical site infections. All 6 patients (100%) experienced prolonged hospitalization, indicating that extended length of stay was present in every case. Emergency surgery was performed in 4 patients (66.7%), highlighting its important role as a risk factor.

With respect to wound classification, Class IV (dirty–infected) wounds were observed in 3 patients (50%), while Class II (clean–contaminated) wounds were identified in 2 patients (33.3%). Class I (clean) wounds accounted for 1 patient (16.7%), whereas Class III (contaminated) wounds were not observed (0 patients, 0%). In addition, comorbid conditions (e.g., metabolic or chronic diseases) were present in 2 patients (33.3%).

Overall, prolonged hospitalization and emergency surgery were the most common risk factors, while higher wound contamination classes—particularly Class IV—were strongly associated with the occurrence of surgical site infections.

Bloodstream infections. All 13 patients (100%) had prolonged hospitalization, indicating that extended length of stay was a universal characteristic among patients with nosocomial bloodstream infections. Central venous catheterization was also present in all 13 patients (100%), underscoring its strong association with bloodstream infection development.

Chronic comorbid conditions were identified in 4 patients (30.8%), suggesting a moderate contribution of underlying diseases to infection risk. Immunosuppressive conditions or therapy were documented in 1 patient (7.7%), representing a smaller proportion of cases.

Overall, the findings demonstrate that prolonged hospitalization and central venous catheterization were consistent and dominant risk factors, while comorbidities and immunosuppression played a contributory role in a subset of patients.

Identification of Causative Pathogens.

Each nosocomial infection was caused by the invasion of one or more pathogens into the host. Among the 59 identified nosocomial infections, a total of 17 different causative pathogens were detected. The distribution of pathogens is presented in Table 2.

Table 2. Causative pathogens

Gram-negative bacteria (GNB) – high antimicrobial resistance	Gram-positive bacteria (GPB) – nosocomial and opportunistic infections	Fungal (mycotic) infections
Acinetobacter baumannii (n 16) *Acinetobacter spp.* (n 2) *Escherichia coli* (n 12) *Klebsiella pneumoniae subsp. pneumoniae* (n 24) *Pseudomonas aeruginosa* (n 4) *Proteus mirabilis* (n 3)	*Enterococcus faecalis* (n 4) *Enterococcus faecium* (n 8) *Staphylococcus aureus* (MRSA and MSSA) (n 6) *Staphylococcus haemolyticus* (coagulase-negative staphylococci, catheter-associated infections) (n 1) Coagulase-negative *Staphylococcus spp.* (n 2) *Streptococcus salivarius* (n 1) *Streptococcus spp.* (n 3) *Corynebacterium spp. (C. jeikeium, C. striatum*-associated with sepsis in immunocompromised patients) (n 5)	*Candida albicans* (n 8) *Candida glabrata* (fluconazole-resistant candidemia and deep infections) (n 2) *Candida krusei* (intrinsically resistant to antifungal therapy) (n 1)

Analysis of bacteriological tests demonstrated that the largest proportion of causative pathogens (51%) was identified through sputum cultures. Of 52 pathogens isolated from respiratory samples, 43 cases (82.7%) were detected in patients treated in the intensive care unit (ICU).

The second most frequent source of pathogen identification was urine culture, accounting for 33.3% of isolates. Among 34 urinary isolates, 20 cases (58.8%) were detected in patients hospitalized in the ICU.

Causative pathogens of surgical site infections and bloodstream infections were identified in all cases (8/8). Wound swab cultures most frequently yielded pathogens in ICU patients (6 of 8 cases, 75%), whereas blood culture–positive isolates were more commonly detected in the therapeutic (medical) department (37.5%).

Overall, gram-negative multidrug-resistant organisms, particularly *Klebsiella pneumoniae* and *Acinetobacter baumannii,* were the predominant causative agents of nosocomial infections, with the highest burden observed in critically ill patients treated in intensive care units.

Discussion and Conclusions. Based on the findings of this study, the incidence of nosocomial infections, calculated for at-risk patients, was 2.37% (59/2,494), while the case fatality rate was 27.1% (16/59). These results are consistent with international standards, indicating that the incidence of nosocomial infections did not exceed recommended threshold values. According to World Health Organization (WHO) recommendations, the incidence among at-risk populations should not exceed 7–10% [40]. In the present study, the observed incidence was substantially lower, at 2.37%.

However, with regard to mortality, WHO guidelines suggest that under general clinical conditions the case fatality rate should not exceed 10% [1], whereas in this study it reached 27.1%. This elevated mortality rate may be attributed to the inability to determine whether death was primarily caused by the underlying diagnosis or by the nosocomial infection itself. On the one hand, this represents a limitation at the institutional level, as detailed and systematic investigations of individual cases by the Infection Prevention and Control Committee were not available. On the other hand, it may reflect a broader systemic limitation, including insufficiently rigorous monitoring of each recorded nosocomial infection.

Analysis of the monthly distribution of nosocomial infections demonstrated that the highest number of cases occurred during the first quarter of the year, with 28 of the 59 infections identified during this period. Concurrently, the timing of infection prevention and control trainings was reviewed, revealing a notable association: in March, medical staff received training on hand hygiene, after which the trend in infection incidence showed a declining pattern. As attendance reached 85% of medical personnel, it can be reasonably assumed that full participation could have an even greater impact on reducing nosocomial infection rates.

A substantially higher number of nosocomial infections was observed among emergency-admitted patients. Of the 59 recorded infections, 52 cases (88.14%) occurred in patients who received emergency medical care. This finding may be explained by both the severity of patients' clinical conditions and the specific characteristics of emergency care management. In emergency situations, strict adherence to hygienic standards may be compromised due to the priority of life-saving interventions. Moreover, patients admitted on an emergency basis often present with severe primary diagnoses and impaired immune status, which increases susceptibility to infectious agents.

According to grouped data analysis, 54.2% of nosocomial infections occurred in patients aged 71 years and older. This may be attributed to the increased prevalence of multiple chronic conditions with advancing age, a marked decline in immune function, prolonged hospitalization, and frequent need for invasive procedures such as mechanical ventilation and catheterization, all of which are associated with higher risks of complications and mortality.

Globally, nearly 50% of nosocomial infections are attributed to catheter-associated urinary tract infections [6], and the findings of this study are consistent with this pattern. Urinary tract infections ranked among the most common infection types identified. In the present study, 100% of affected patients underwent urinary bladder catheterization, which—together with prolonged hospitalization—is recognized in international literature as one of the most significant risk factors [6].

The study further revealed that surgical intervention was an important contributing factor in the development of nosocomial bloodstream infections. In 30.8% of confirmed cases, this risk factor was present in combination with prolonged hospitalization and vascular catheterization. While this may be related to breaches in aseptic and antiseptic practices, conclusive evidence could not be established within the scope of the present study.

Across all four nosocomial infection types analyzed, a consistent pattern of shared and infection-specific risk factors was identified. Prolonged hospitalization emerged as a universal risk factor, present in 100% of cases across all infection categories, underscoring the strong association between extended length of stay and the development of healthcare-associated infections. Invasive medical procedures played a central role in infection occurrence. Mechanical ventilation was documented in the vast majority of patients with nosocomial pneumonia, while urinary bladder catheterization was present in all patients with urinary tract infections. Similarly, central venous catheterization was identified in all cases of bloodstream infections, confirming its critical role as a predisposing factor. In surgical site infections, emergency surgery and higher wound contamination classes, particularly Class IV (dirty–infected wounds), were strongly associated with infection development. Patient-related factors, including advanced age, chronic comorbidities, and immunosuppression, contributed variably across infection types. Comorbid conditions were more frequently observed in patients with pneumonia and bloodstream infections, while immunosuppression played a smaller but clinically relevant role. Notably, elective admissions were associated with substantially lower infection rates compared with emergency admissions, highlighting emergency hospitalization as an important independent risk factor.

Overall, the findings indicate that nosocomial infections result from a multifactorial interaction between prolonged hospitalization, invasive procedures, clinical urgency, and patient vulnerability. These results emphasize the need for targeted infection prevention and control strategies, particularly focused on high-risk patients, invasive device management, and early risk stratification in emergency and intensive care settings.

References:

1. Allegranzi B. *Health care without avoidable infections: the critical role of infection prevention and control.* Geneva: World Health Organization; 2016. Report No.: WHO/HIS/SDS/2016.10.
2. Allegranzi B, Nejad SB, Combescure C, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2011;377(9761):228–241. doi:10.1016/S0140-6736(10)61458-4.
3. European Centre for Disease Prevention and Control. Surveillance of antimicrobial resistance in Europe 2019. Stockholm: ECDC; 2020.
4. Magill SS, Edwards JR, Bamberg W, et al. Multistate point-prevalence survey of health care–associated infections. N Engl J Med. 2014;370(13):1198–1208. doi:10.1056/NEJMoa1306801.
5. Ministry of Labour, Health and Social Affairs of Georgia. Order No. 01-38/N of 7 September 2015 on approval of rules for epidemiological surveillance, prevention and control of nosocomial infections. Tbilisi: Ministry of Labour, Health and Social Affairs of Georgia; 2015.
6. Rubi H, Mudey G, Kunjalwar R. Catheter-Associated Urinary Tract Infection (CAUTI). Cureus. 2022 Oct 17;14(10):e30385. doi: 10.7759/cureus.30385. PMID: 36407206; PMCID: PMC9668204
7. World Health Organization. Antimicrobial resistance: global report on surveillance. Geneva: World Health Organization; 2014.
8. World Health Organization. Global report on infection prevention and control. Geneva: World Health Organization; 2022.
9. World Health Organization. Report on the burden of endemic health care-associated infection worldwide. Geneva: World Health Organization; 2011.

HELEN PHAGAVA, MARIAM SANIKIDZE, SOFIKO GURAMISHVILI, IRAKLI MCHEDLISHVILI

FREQUENCY, PREVALENCE AND RISK FACTORS OF NOSOCOMIAL INFECTIONS: THE CASE OF A MULTIDISCIPLINARY HOSPITAL IN TBILISI, GEORGIA

Department of Epidemiology and Biostatistics, Tbilisi State Medical University

SUMMARY

Background: Nosocomial infections, also known as healthcare-associated infections, remain a major challenge for healthcare systems worldwide, contributing to increased morbidity, mortality, length of hospital stay, and healthcare costs. Despite established surveillance regulations in Georgia, hospital-level data on infection patterns and risk factors remain limited.

Objective: To determine the prevalence, major clinical forms, risk factors, and causative microorganisms of nosocomial infections in a multidisciplinary hospital in Tbilisi.

Materials and Methods: A retrospective descriptive study was conducted using medical records and electronic data of hospitalized patients treated between 01 January 2023 and 01 January 2024. Among 2,984 hospitalized patients, 2,494 remained in hospital for more than 48 hours and were considered at risk. Nosocomial infections were identified and analyzed by type of hospitalization, age, outcomes, invasive procedures, and microbiological findings. Descriptive statistical methods were applied.

Results: A total of 59 nosocomial infections were identified, yielding an incidence of 2.37%, which was below internationally recommended thresholds. The case fatality rate was 27.1%. The most frequent infections were pneumonia (33.9%) and urinary tract infections (33.9%), followed by bloodstream infections (22.0%) and surgical site infections (10.2%). Most infections occurred among emergency-admitted patients (88.1%) and patients aged ≥71 years (54.2%). Prolonged hospitalization and invasive procedures—including mechanical ventilation, urinary catheterization, and central venous catheterization—were identified as universal risk factors. Gram-negative multidrug-resistant bacteria, particularly *Klebsiella pneumoniae* and *Acinetobacter baumannii*, predominated. A reduction in infection incidence was observed following hand hygiene training for medical staff.

Conclusions: Although the incidence of nosocomial infections remained within acceptable limits, the high mortality rate highlights the vulnerability of elderly, critically ill, and emergency-admitted patients. Strengthening infection prevention and control measures, improving surveillance and outcome attribution, and targeting high-risk groups are essential to reduce the burden of nosocomial infections.

Keywords: nosocomial infections; healthcare-associated infections; incidence; risk factors; Georgia