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# Prevalence and Microbial Etiology of Catheter-Related Bloodstream Infections in a University Hospital in North Cyprus: A Retrospective Study

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## Abstract

**BACKGROUND/AIMS:** This study aimed to determine the incidence of central venous catheter-related bloodstream infections (CRBSI) and to identify specific pathogens in three intensive care units (ICUs) at a university hospital in North Cyprus during 2022-2023.

**MATERIALS AND METHODS:** A retrospective investigation was conducted using data collected from medical records via the electronic information system. The records provided details on patient demographics, incidence density rates, microbial isolates, and resistance profiles within the ICUs.

**RESULTS:** In total, 48 cases were analyzed. The overall CRBSIs incidence density was 17.2 per 1000 catheter days. The General ICU had the highest CRBSI incidence at 30.2 per 1,000 catheter days, whereas the Cardiovascular Surgery ICU recorded 0.0 per 1000 catheter days. Among the 48 cases, a total of 49 bacterial isolates were identified, including one case with dual bacterial strains. *Klebsiella pneumoniae* was the leading causative agent, found in 16 isolates (32.7%), followed by *Staphylococcus epidermidis* in 10 isolates (20.4%). Of the 49 bacterial isolates, resistance was observed in 35. Extended-spectrum beta-lactamase production was detected in 12 (24.5%) *K. pneumoniae* isolates, 3 (6.1%) *Proteus mirabilis* isolates, and 1 (2.0%) *Escherichia coli* isolate. In addition, methicillin resistance was noted in 10 *S. epidermidis* (20.4%), 7 *Staphylococcus haemolyticus* (14.3%), and 2 *Staphylococcus hominis* (4.1%) isolates.

**CONCLUSION:** These findings support continued implementation of protective and preventive measures in hospital ICUs for effective CRBSI management.

**Keywords:** Catheter-related bloodstream infections, central venous catheter, intensive care units

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## INTRODUCTION

Catheter-related bloodstream infections (CRBSIs) continue to be a major problem in healthcare institutions due to their association with increased rates of hospitalization, death, and the high costs related to healthcare.[1] According to recent research, individuals who have either a central venous catheter (CVC) or peripheral venous catheter (PVC) are at risk of central line-associated bloodstream infections or peripheral line-associated bloodstream infections, respectively.[2,3]

Various risk factors are linked to the occurrence of CRBSIs. These include the patient's age, pre-existing medical conditions, and variables related to the catheter itself, such as material, type, insertion location, and length of use.[4,5] Despite numerous preventive methods employed by health institutions to mitigate these risks, clinical data still indicate that a significant proportion of CRBSIs are linked to the use of catheters (CVC and PVC).[6]

The persistence of CRBSIs, despite advanced preventive technologies and protocols, underscores the need for ongoing research into both the epidemiological trends and the effectiveness of different prevention strategies across various clinical settings. Studies have shown that while overall rates of CRBSIs have declined due to infection control measures, certain populations within hospital settings, such as intensive care unit (ICU) patients, remain at high risk. This suggests that factors specific to different ICU environments might influence infection rates, necessitating tailored approaches to infection control.[7]

Moreover, the microbiological landscape of CRBSIs has evolved, with shifts in the prevalence of pathogens and their resistance patterns posing new challenges for treatment and management. The shifts in the prevalence of antibiotic-resistant organisms further complicate the clinical management of these infections, making the timely and accurate identification of causative agents and their susceptibility patterns critical for effective treatment.[8]

Given these challenges, this study aimed to investigate the incidence density of CRBSIs within the general, coronary, and cardiovascular surgery ICUs in a hospital during 2022-2023.

## MATERIALS AND METHODS

### Ethical Considerations

This study was carried out with the approval of the Near East University Scientific Ethics Committee (approval number: 2023/115, date: 21.06.2023).

### Study Design and Setting

This retrospective study was conducted at a University Hospital in North Cyprus, focusing on the incidence of CRBSIs within the ICU departments (general ICU, coronary ICU, and cardiovascular surgery ICU) throughout the years 2022 to 2023.

### Participants

The study population comprised adult patients (≥18 years) who were admitted to the ICUs with CVCs inserted. Patients were included if they developed CRBSIs during their ICU stay, as defined by the Centers for Disease Control and Prevention guidelines for diagnosing CRBSIs.[9]

### Data Collection

Data were retrospectively collected from electronic medical records, including patient demographics (age, gender), CVC details (type, insertion site, duration), and laboratory results. CRBSIs were identified based on positive blood culture results obtained from samples drawn from peripheral veins and the catheter, in conjunction with clinical signs of infection.

### Statistical Analysis

All analyses were performed using descriptive statistical methods. Incidence density rates of CRBSIs were calculated as the number of CRBSI episodes per 1,000 catheter days. Descriptive statistics were used to summarize patient demographics and CVC characteristics, expressing categorical variables as frequencies (n) and percentages (%), and continuous variables (e.g., age) as means ± standard deviation, and medians (minimum-maximum) where appropriate. The standardized infection ratio (SIR) was calculated by dividing the observed number of infections by the predicted number of infections, in line with established national benchmarks.

## RESULTS

### Demographics

During the study period, 48 cases of CRBSIs were identified among ICU patients. The mean and median ages of the patients were 72.00±11.18 and 74.00 (range: 40.00-89.00), respectively. Male patients were predominant (60.4%).

### Incidence

### Case Distribution

**General intensive care unit:** Of the 48 cases of CRBSIs identified during the study period, the general ICU reported the highest number of cases (n=35), accounting for 72.9% of all cases.

**Coronary intensive care unit:** The coronary ICU reported 13 CRBSI cases, comprising 27.1% of total cases.

**Cardiovascular Surgery:** the cardiovascular surgery ICU reported no CRBSI cases (Figure 1).

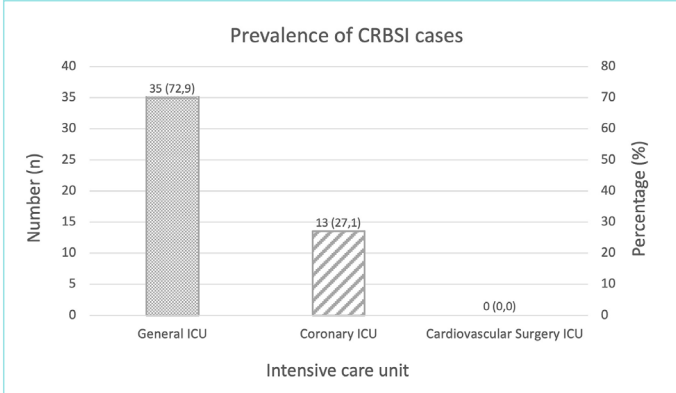


**Figure 1.** Prevalence of catheter-related bloodstream infections cases in the intensive care units of a New East University Hospital, 2022-2023.

CRBSI: Catheter-related bloodstream infections, ICU: Intensive care unit.

### Incidence Density Rates

**General intensive care unit:** The general ICU had a total of 1,159 CVC days with an incidence density of 30.2 per 1,000 catheter days.

**Coronary intensive care unit:** With 1,362 CVC days recorded, the incidence density in the coronary. The rate of infection in the ICU was 9.5 per 1,000 catheter days.

**Cardiovascular surgery:** There were 296 CVC days with no CRBSIs, resulting in an incidence density rate of 0.0 per 1,000 catheter days (Figure 2).

### Standardized Infection Ratio

**General intensive care unit:** The SIR for the general ICU was 7.0, calculated from 35 observed infections against 5 predicted infections.

**Coronary intensive care unit:** The SIR for the coronary ICU was 2.6, with 13 observed infections compared to 5 predicted infections.

**Cardiovascular surgery:** The SIR was 0.0, with no observed infections against a predicted 5 infections (Figure 2).

### Yearly Overall Incidence Results

Overall, there were 25 CRBSIs in 2022, for a total of 1,319 CVC days and this resulted in a CRBSI incidence density of 18.9 per 1,000 catheter days. In 2023, 23 cases of CRBSI were recorded for a total number of 1,418 CVC days, resulting in a CRBSI rate of 15.5 per 1,000 catheter days. This gave a cumulative duration of 2,737 CVC days and an overall incidence density or rate of CRBSIs of 17.2 per 1,000 catheter days. The overall SIR across all ICUs was 9.6, with 48 observed infections against 5 predicted infections (Figure 3).

### Microbial Etiology

In the analysis of CRBSI cases, a total of 49 bacterial isolates were identified. Among these, gram-negative bacteria comprised more than half of the isolates (n=26; 53.1%), with *Klebsiella pneumoniae* being the predominant pathogen (n=16; 32.7%) (Figure 4). On the other hand, gram-positive bacteria accounted for a significant portion (n=23; 46.9%), with *Staphylococcus epidermidis* emerging as the most common gram-positive bacterial isolate (n=10; 20.4%) (Figure 5).

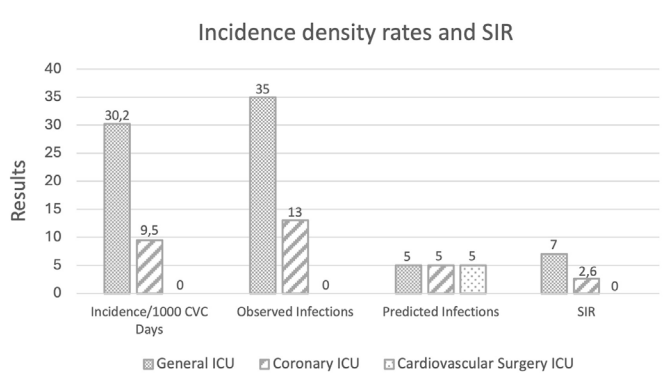


**Figure 2.** Incidence density rates and standardized infection ratios of catheter-related bloodstream infections at the New East University Hospital, 2022-2023.

SIR: Standardized infection ratio, CVC: Central venous catheter, ICU: Intensive care unit.

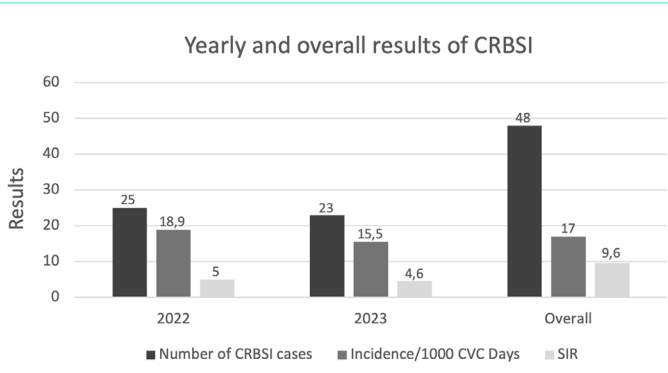


**Figure 3.** Yearly and overall results of catheter-related bloodstream infections at the New East University Hospital, 2022-2023.

CRBSI: Catheter-related bloodstream infections, CVC: Central venous catheter, SIR: Standardized infection ratio.

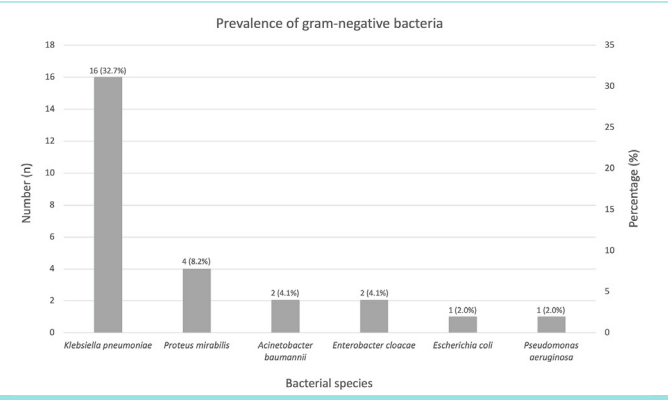


**Figure 4.** Prevalence of gram-negative bacteria isolated from catheter-related bloodstream infections at the New East University Hospital, 2022-2023.

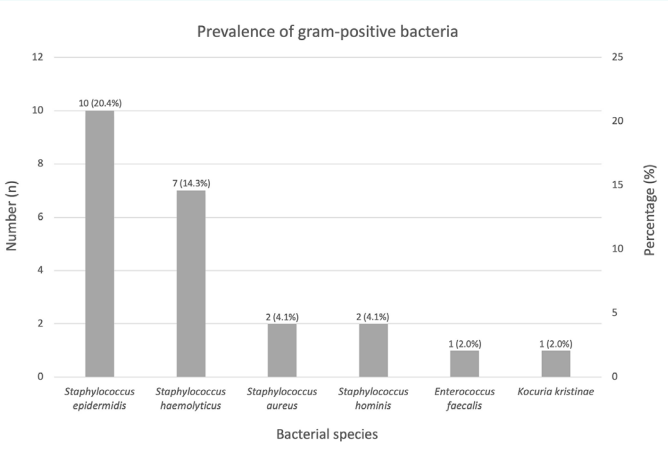


**Figure 5.** Prevalence of gram-positive bacteria isolated from catheter-related bloodstream infections at the New East University Hospital, 2022-2023.

### Antimicrobial Resistance Patterns

Among the 49 bacterial isolates identified, 35 were resistant, categorized as either extended-spectrum beta-lactamase (ESBL) producers, or methicillin-resistant staphylococci. Of these resistant isolates, 16 (32.7%) were ESBL producers, with *K. pneumoniae* being the most prevalent among them (n=12; 24.5%) (Figure 6). On the other hand, methicillin resistance was detected in 19 (38.8%) of the coagulase-negative staphylococci, with *S. epidermidis* being the most affected (n=10; 20.4%) bacterial species (Figure 7). In this study, methicillin-resistant *Staphylococcus aureus* was not isolated from the patients.

## DISCUSSION

The study presented here, documented the incidence density of CRBSIs to be 17.2 per 1,000 catheter days. The incidence density reported in this study is higher than that noted in prior research, including the rates of 5 per 1,000 catheter days and 3.52 per 1,000 catheter days reported by Abd El-Hamid El-Kady et al.[10] and Zhang et al.[11], respectively. In the present study, a peak incidence density of 18.9 per 1,000 catheter days was observed in 2022, albeit with a subsequent decline to 15.5 per 1,000 catheter days in 2023. This aligns with findings from Zhong et al.[12]

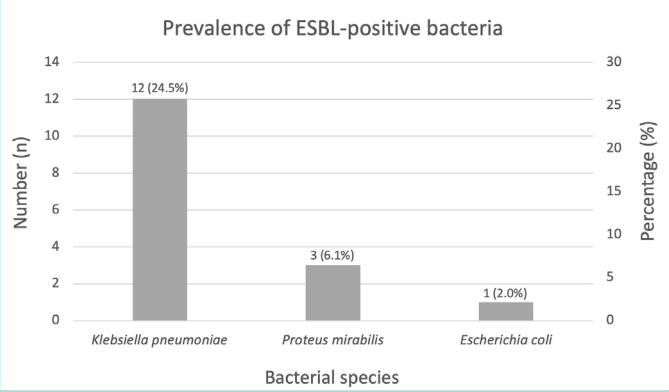


**Figure 6.** Prevalence of extended-spectrum beta-lactamase (ESBL)-positive bacteria isolated from catheter-related bloodstream infections at the New East University Hospital, 2022-2023.

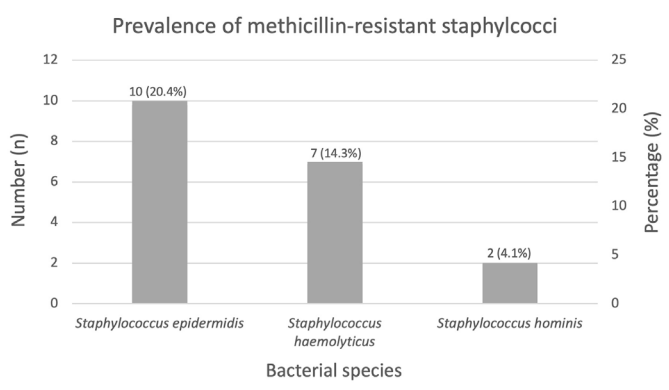


**Figure 7.** Prevalence of methicillin-resistant staphylococci (MRS) isolated from catheter-related bloodstream infections at the New East University Hospital, 2022-2023.

*No methicillin-resistant *Staphylococcus aureus* isolate was identified in this study.

and Drugeon et al.[13] highlighting the vulnerability of elderly patients due to diminished immune responses, leading to prolonged ICU stays and recovery periods. Moreover, the study population in our research predominantly comprised males, a demographic characteristic that aligns with other studies.[14]

The disparity in CRBSI incidence density between different ICU units, notably between the general ICU and the cardiovascular surgery ICU, may be influenced by several factors. A study by Pronovost et al.[15] showed that targeted infection control interventions can significantly reduce CRBSI rates. In environments like the general ICU, where a variety of invasive procedures are common, the potential for infection might be elevated, thereby increasing CRBSI rates. In contrast, the cardiovascular surgery ICU might exhibit lower or non-existent CRBSI rates as in our study. This lower incidence can be attributed not just to the adherence to strict infection control protocols but also to the relatively low number of patients admitted to this unit, as evidenced by the notably fewer CVC days (296 over the study period). The reduced patient turnover in this specialized unit likely contributes to lower rates of infection, highlighting the impact of patient number on CRBSI rates.

The study identified 49 bacterial isolates associated with CRBSIs, predominantly gram-negative bacteria, with *K. pneumoniae* emerging as the most frequent pathogen. This aligns with the findings of Zhang et al.[11], but contrasts with other reports where Gram-positive bacteria like *S. epidermidis* were more prevalent.[16,17] Notably, *S. epidermidis* was identified as the most common gram-positive isolate in our study, consistent with its known prevalence in CRBSIs, as reported in the literature, often due to its biofilm-forming capabilities, which enhance its persistence on indwelling medical devices.[18]

In the present study, an uncommon gram-positive isolate, *Kocuria kristinae*, was also detected. Although rare, its presence in CRBSIs was documented previously.[19] The characteristics of *K. kristinae*, including its resistance to antibiotics, underline the need for further study in clinical settings.

The observed antimicrobial resistance patterns showed a significant presence of ESBL-producing and methicillin-resistant isolates. *K. pneumoniae* was the most common ESBL producer. The rates of ESBL positivity and methicillin resistance in our study are consistent with increasing trends noted in recent literature; however, the ESBL rate found in the present study is higher than earlier findings.[20] Unlike the previous study, the present report included the patients from the ICU departments; therefore, this explains the increased resistance rates in this study. Yet, the present findings suggest that infection control practices should be continuously implemented in healthcare settings.

### Study Limitations

This study was carried out in a single hospital, which may limit how well the results apply to other healthcare settings with different types of patients, infection control practices, or resistance patterns. Additionally, we did not perform molecular testing to identify resistance genes or assess the ability of bacteria to form biofilms. In addition, important risk factors like patient health conditions and previous use of antibiotics were not thoroughly examined.

## CONCLUSION

In conclusion, the elevated rates of incidence density and SIR underscore the necessity for preventive measures and continuous monitoring of antimicrobial resistance in the ICU. Our findings highlight the need for more comprehensive studies that search for the molecular characteristics of the bacterial agents isolated from the CRBSIs, particularly in critical healthcare settings.

## MAIN POINTS

- The study retrospectively analyzed 48 cases of catheter-related bloodstream infections (CRBSIs) in intensive care unit (ICU) patients during 2022-2023, with an overall incidence density of 17.2 per 1,000 catheter days.
- The General ICU exhibited the highest CRBSI incidence (30.2 per 1,000 catheter days), whereas the Cardiovascular Surgery ICU reported no infections.
- *Klebsiella pneumoniae* (32.7%) was the leading pathogen, followed by *Staphylococcus epidermidis* (20.4%), indicating a diverse microbial etiology.
- High rates of antimicrobial resistance were observed, with *K. pneumoniae* (n=12; 24.5%) having the highest number of extended-spectrum beta-lactamase positive isolates and *Staphylococcus epidermidis* (n=10; 20.4%) having the highest number of methicillin resistant isolates.
- These findings underscore the critical need for continuous and targeted infection control measures in ICU settings to effectively manage and prevent CRBSIs.

## ETHICS

**Ethics Committee Approval:** This study was carried out with the approval of the Near East University Scientific Ethics Committee (approval number: 2023/115, date: 21.06.2023).

**Informed Consent:** Retrospective study.

### Footnotes

### Authorship Contributions

Concept: A.P.P.T., H.K.S., E.R., Design: H.C.Y., H.K.S., E.R., Data Collection and/or Processing: S.S.S., H.C.Y., A.T., M.Y., Analysis and/or Interpretation: A.P.P.T., S.S.S., H.C.Y., H.K.S., E.R., Literature Search: A.P.P.T., S.S.S., A.T., M.Y., E.R., Writing: A.P.P.T., S.S.S.

## DISCLOSURES

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study had received no financial support.

## REFERENCES

1. Gahlot R, Nigam C, Kumar V, Yadav G, Anupurba S. Catheter-related bloodstream infections. Int J Crit Illn Inj Sci. 2014; 4(2): 162-7.
2. Osório N, Oliveira V, Costa MI, Santos-Costa P, Serambeque B, Gama F, et al. Short peripheral venous catheters contamination and the dangers of bloodstream infection in Portugal: an analytic study. Microorganisms. 2023; 11(3): 709.
3. Teja B, Bosch NA, Diep C, Pereira TV, Mauricio P, Sklar MC, et al. Complication rates of central venous catheters: a systematic review and meta-analysis. JAMA Intern Med. 2024; 184(5): 474-82.
4. Simon A, Ammann RA, Bode U, Fleischhack G, Wenchel HM, Schwamborn D, et al. Healthcare-associated infections in pediatric cancer patients: results of a prospective surveillance study from university hospitals in Germany and Switzerland. BMC Infect Dis. 2008; 8: 70.
5. Kaye KS, Patel DA, Stephens JM, Khachatryan A, Patel A, Johnson K. Rising United States Hospital admissions for acute bacterial skin and skin structure infections: recent trends and economic impact. PLoS One. 2015; 10(11): e0143276.
6. Ista E, van der Hoven B, Kornelisse RF, van der Starre C, Vos MC, Boersma E, et al. Effectiveness of insertion and maintenance bundles to prevent central-line-associated bloodstream infections in critically ill patients of all ages: a systematic review and meta-analysis. Lancet Infect Dis. 2016; 16(6): 724-34.
7. Badia-Cebada L, Peñafiel J, Saliba P, Andrés M, Càmara J, Domenech D, et al. Trends in the epidemiology of catheter-related bloodstream infections; towards a paradigm shift, Spain, 2007 to 2019. Euro Surveill. 2022; 27(19): 2100610.
8. Rodríguez-Créixems M, Muñoz P, Martín-Rabadán P, Cercenado E, Guembe M, Bouza E. Evolution and aetiological shift of catheter-related bloodstream infection in a whole institution: the microbiology department may act as a watchtower. Clin Microbiol Infect. 2013; 19(9): 845-51.
9. O'grady NP, Alexander M, Dellinger EP, Gerberding JL, Heard SO, Maki DG, et al. Guidelines for the prevention of intravascular catheter-related infections. Am J Infect Control. 2002; 30(8): 476-89.
10. Abd El-Hamid El-Kady R, Waggas D, AkL A. Microbial repercussion on hemodialysis catheter-related bloodstream infection outcome: a 2-year retrospective study. Infect Drug Resist. 2021; 14: 4067-75.
11. Zhang Y, Wang Y, Sheng Z, Wang Q, Shi D, Xu S, et al. Incidence Rate, Pathogens and Economic burden of catheter-related bloodstream infection: a single-center, retrospective case-control study. Infect Drug Resist. 2023; 16: 3551-60.
12. Zhong Y, Zhou L, Liu X, Deng L, Wu R, Xia Z, et al. Incidence, risk factors, and attributable mortality of catheter-related bloodstream infections in the intensive care unit after suspected catheters infection: a retrospective 10-year cohort study. Infect Dis Ther. 2021; 10(2): 985-99.
13. Drugeon B, Guenezan J, Pichon M, Devos A, Fouassin X, Neveu A, et al. Incidence, complications, and costs of peripheral venous catheter-related bacteraemia: a retrospective, single-centre study. J Hosp Infect. 2023; 135: 67-73.
14. Pitiriga V, Kanellopoulos P, Bakalis I, Kampos E, Sagris I, Saroglou G, et al. Central venous catheter-related bloodstream infection and colonization: the impact of insertion site and distribution of multidrug-resistant pathogens. Antimicrob Resist Infect Control. 2020; 9(1): 189.
15. Pronovost P, Needham D, Berenholtz S, Sinopoli D, Chu H, Cosgrove S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. N Engl J Med. 2006; 355(26): 2725-32.
16. Tao F, Jiang R, Chen Y, Chen R. Risk factors for early onset of catheter-related bloodstream infection in an intensive care unit in China: a retrospective study. Med Sci Monit. 2015; 21: 550-6.
17. Sato A, Nakamura I, Fujita H, Tsukimori A, Kobayashi T, Fukushima S, et al. Peripheral venous catheter-related bloodstream infection is associated with

severe complications and potential death: a retrospective observational study. BMC Infect Dis. 2017; 17(1): 434.

18. Ruiz-Giardin JM, Ochoa Chamorro I, Velázquez Ríos L, Jaqueti Aroca J, García Arata MI, SanMartín López JV, et al. Blood stream infections associated with central and peripheral venous catheters. BMC Infect Dis. 2019; 19(1): 841.

19. Kimura M, Kawai E, Yaoita H, Ichinoi N, Sakamoto O, Kure S. Central venous catheter-related bloodstream infection with kocuria kristinae in a patient with propionic acidemia. Case Rep Infect Dis. 2017; 2017: 1254175.

20. Ruh E, Gazi U, Güvenir M, Süer K, Çakır N. Antibiotic resistance rates of pseudomonas aeruginosa, acinetobacter baumannii and klebsiella pneumoniae isolated from a university-affiliated hospital in North Cyprus. Turk Hij Den Biyol Derg. 2016; 73(4): 333-44.