

Bacteremia Prevalence and Risk Factors at PKU Muhammadiyah Gamping Hospital, Yogyakarta

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Abstract

Purpose: This study aimed to analyze the prevalence and risk factors of bacteremia at PKU Muhammadiyah Gamping Hospital, Yogyakarta.

Research Methodology: This study employed an analytical observational design with a case-control approach. The sample consisted of hospitalized patients diagnosed with bacteremia between January 2020 and December 2021, selected based on predefined inclusion and exclusion criteria of this study.

Results: A total of 133 patients were included in this study. Statistical analysis showed that several variables were significantly associated with bacteremia, including age ($p = 0.001$; OR = 2.87), fever ($p = 0.02$; OR = 1.94), vomiting ($p = 0.003$; OR = 2.33), and abdominal pain ($p = 0.016$; OR = 2.29).

Conclusions: The prevalence of bacteremia was identified in 133 patients, with age and clinical symptoms, particularly fever, vomiting, and abdominal pain, emerging as significant risk factors.

Limitations: This study was conducted in a single hospital setting, which may limit the generalizability of the findings to other healthcare settings with different patient characteristics and epidemiological profiles.

Contributions: The findings provide important epidemiological insights that can support hospitals in identifying risk patterns and improving the management of bacteremia in clinical practice.

Keywords: *Bacteriemia, Hospital, Prevalence, Risk Factors*

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1. Introduction

Bacteremia is a clinical condition characterized by the presence of viable bacteria in the bloodstream (Holmes, Anderson, Mobley, & Bachman, 2021). Under normal physiological conditions, the bloodstream is a sterile environment, and the presence of microorganisms indicates a disruption of the body's natural defense mechanisms or invasion of pathogens from other sites of infection (Holmes, Albin, Mobley, & Bachman, 2025). Bacteremia can occur transiently, intermittently, or persistently, depending on the source and severity of infection. In many cases, bacteremia originates from localized infections such as pneumonia, Urinary Tract Infections (UTIs), intra-abdominal infections, or infections associated with medical devices. Although transient bacteremia may resolve spontaneously in healthy individuals owing to an effective immune response, persistent bacteremia can lead to severe systemic complications, including sepsis, septic shock, and multi-organ failure, which significantly increase morbidity and mortality rates (Forrester, 2024).

Bacteremia often occurs after invasive medical or dental procedures that allow bacteria to enter the bloodstream and cause infections. The use of dental or medical equipment, invasive diagnostic procedures, and even routine activities such as aggressive tooth brushing can introduce bacteria into the bloodstream (Setyoningrum et al., 2024). Individuals with certain medical conditions, particularly those

with heart valve disorders, prosthetic heart valves, artificial joints, or other implanted medical devices, are more susceptible to developing bacteremia. In such patients, circulating bacteria may adhere to prosthetic surfaces or damaged tissues, potentially leading to serious complications such as infective endocarditis or prosthetic joint infection ([Ervina et al., 2025](#)). Therefore, prophylactic antibiotic administration prior to certain dental or medical procedures is often recommended for high-risk patients to prevent bacteremia-related complications ([Forrester, 2024](#)).

Accurate and timely diagnosis of bacteremia is essential for effective clinical management and prevention of severe complications of the disease. One of the primary responsibilities of clinical microbiology laboratories is to detect and identify bacteria circulating in the bloodstream. Bacteremia is commonly diagnosed using blood cultures. Conventional methods include manual systems, such as biphasic blood culture techniques, lysis-centrifugation filtration, and manometric methods, which have been historically used to detect microbial growth. In addition to these conventional techniques, modern automated blood culture systems, both radiometric and non-radiometric, have been developed to improve detection accuracy and efficiency. However, despite these technological advancements, the diagnostic process still requires a relatively long incubation period. Blood culture results generally become available within two to five days, and in some cases, the incubation period may exceed five days, which may delay clinical decision-making and appropriate antimicrobial therapy ([Ruiz-Giardin et al., 2015](#)).

Bacteremia is frequently associated with various primary infections, particularly Urinary Tract Infections (UTIs), which are among the most common infectious diseases worldwide. Studies have reported that the incidence of bacteremia in patients with febrile urinary tract infections ranges from approximately 5% to 31%, depending on factors such as patient age, underlying medical conditions, and healthcare settings. In certain patient populations, particularly infants and older adults, bacteremia associated with urinary tract infections may result in more severe clinical outcomes. Although some studies have reported favorable outcomes in infants with bacteremia-related UTIs when treated promptly, these cases remain clinically significant because they can lead to serious complications, including prolonged hospitalization, septic shock, bacterial meningitis, and the need for Intensive Care Unit (ICU) admission ([Yoon et al., 2020](#)).

Various clinical and medical factors can increase the risk of developing bacteremia. These include invasive medical procedures such as dental treatments, insertion of intravenous, central venous, or urinary catheters, and mechanical ventilation involving the placement of endotracheal tubes to assist breathing ([Ridho & Artikel, 2023](#)). Surgical procedures and prolonged hospitalization are also recognized risk factors because they may expose patients to hospital-acquired infections and increase the likelihood of bacterial bloodstream infections. In addition, patients with weakened immune systems, chronic diseases, or those using invasive medical devices are particularly vulnerable to bacteremia ([Lockhart et al., 2009](#)).

Despite the clinical importance of bacteremia, its epidemiological patterns and associated risk factors vary across healthcare institutions owing to differences in patient characteristics, clinical practices, and infection control systems. Previous studies have extensively examined bacteremia in tertiary hospitals and high-resource settings; however, empirical evidence from secondary-level hospitals, particularly in Indonesia, remains limited and underexplored. This gap is significant because variations in healthcare infrastructure and patient demographics may lead to different risk profiles and clinical manifestations.

Therefore, this study aimed to analyze the prevalence and identify the risk factors of bacteremia among patients treated at PKU Muhammadiyah Gamping Hospital, Yogyakarta. By focusing on a specific institutional context that has received limited scholarly attention, this study contributes to the existing literature by providing context-specific epidemiological data and identifying clinically relevant risk factors in a developing healthcare setting. The findings are expected to enhance the current understanding of bacteremia beyond well-studied environments and offer practical insights for improving early detection, prevention strategies, and clinical management. Ultimately, this study

contributes to strengthening evidence-based infection control practices and reducing the burden of bacteremia in hospitalized patients.

2. Literature Review

Bacteremia is defined as the presence of viable bacteria in the bloodstream. Under normal conditions, the bloodstream is sterile, and the detection of bacteria indicates the invasion of microorganisms from other sites of infection or the introduction of pathogens through invasive procedures ([Christaki & Giamarellos-Bourboulis, 2014](#)). Bacteremia may occur transiently, intermittently, or persistently, depending on the source and the host's immune response. Transient bacteremia often occurs after minor procedures, such as dental treatment or tooth brushing, whereas persistent bacteremia is usually associated with severe infections, such as pneumonia, urinary tract infections, intra-abdominal infections, or infected medical devices ([Parsons, Westgeest, Conlon, & Fowler Jr, 2023](#)).

Clinically, bacteremia is a significant health concern because it can progress to more severe systemic infections, such as sepsis, septic shock, and multi-organ failure, if not treated promptly ([Srivastava & Singh, 2024](#)). Therefore, the early identification of bacteremia is crucial for effective treatment and prevention of serious complications. Blood culture remains the gold standard for diagnosing bacteremia, although confirmation may take several days ([Fabre, Carroll, & Cosgrove, 2022](#)). Several studies have shown that bacteremia contributes significantly to morbidity and mortality in hospitalized patients. Patients with bacteremia often require longer hospital stays and more intensive treatment and may experience complications such as septic shock or meningitis ([García-Rodríguez & Mariño-Callejo, 2023](#); [Madrazo et al., 2023](#); [Retamar et al., 2014](#)). Age is one of the most frequently reported risk factors for bacteremia.

Elderly patients and infants are generally more vulnerable due to weaker immune systems, which reduce the body's ability to eliminate invading microorganisms ([Amin, Heryanto, Athaya, & Fitri, 2024](#)). Several studies have shown that an increase in age is associated with a higher risk of bloodstream infections and poorer clinical outcomes ([Langi & Winarti, 2024](#)). Sex has also been reported as a potential determinant of bacteremia in several epidemiological studies. Differences in biological characteristics, hormonal factors, and exposure to certain infections may contribute to the variations in the risk of bacteremia between men and women ([Yilmaz et al., 2016](#)).

Invasive medical procedures also play an important role in the development of bacteremia in patients with diabetes. The use of intravenous, central venous, and urinary catheters, as well as mechanical ventilation devices, can increase the risk of bloodstream infection by providing pathways for bacteria to enter the bloodstream. Similarly, recent surgery and prolonged hospitalization have been identified as significant risk factors because of increased exposure to hospital-acquired pathogens ([Keynan & Rubinstein, 2013](#)). The existing literature demonstrates that bacteremia is a multifactorial condition influenced by several key variables. First, demographic factors, particularly age and sex, have been consistently associated with differences in susceptibility to bacteremia, with older patients generally exhibiting a higher risk owing to weakened immune responses. Second, clinical manifestations such as fever, vomiting, and abdominal pain are frequently reported as early indicators that may facilitate the timely diagnosis of bacteremia. Third, underlying infections, especially abdominal and systemic infections, play a critical role as primary sources of bloodstream infection.

Synthesizing these findings, it can be understood that bacteremia arises from the interaction between patient characteristics, presenting symptoms, and infection sources. This theoretical linkage suggests that variations in these variables may significantly influence the incidence of bacteremia in specific hospitals. Therefore, this study hypothesized that demographic factors (age and sex), clinical symptoms (fever, vomiting, and abdominal pain), and underlying infections are significantly associated with bacteremia among hospitalized patients.

3. Methodology

This study employed an analytical observational design with a case-control approach. The study was conducted over a defined period from January 2020 to December 2021. The study population consisted of hospitalized patients diagnosed with bacteremia according to the clinical and laboratory protocols of the hospital. Samples were selected using a consecutive sampling technique from medical records that met the inclusion and exclusion criteria of this study. The inclusion criteria were as follows: all hospitalized patients with a confirmed diagnosis of bacteremia during the study period. The exclusion criteria were incomplete medical records or missing key clinical data required for the analysis.

The operational variables in this study included demographic factors (age, categorized into risk groups, and sex), clinical symptoms (fever, vomiting, and abdominal pain, defined by documented clinical presentation in medical records), and underlying infection (presence of an abdominal infection diagnosed by clinicians). The dependent variable was bacteremia, which was confirmed by laboratory blood culture results according to the hospital standards. Data were collected from the patients' medical records and analyzed using statistical software. A descriptive analysis was performed to summarize the patient characteristics. A bivariate analysis using the chi-square test was conducted to examine the association between the independent variables and the incidence of bacteremia. Variables with p-values < 0.05 were considered statistically significant and were further analyzed using logistic regression to estimate Odds Ratios (ORs) and identify the most dominant risk factors. Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta (No. 054/EC-EXEM-KEPK.FKIK UMY/V/2022).

4. Results and Discussion

4.1 Respondents Characteristics

Table 1. Respondents' characteristic

Variables	Prevalence of Bacteriemia			
	Bacteriemia		Non Bacteriemia	
	Frequency	Percent	Frequency	Percent
Sex				
Female	86	64.7	59	44.4
Male	47	35.3	74	55.6
Age				
>= 45,5	85	63.9	48	36.1
<45,5 th	48	36.1	85	63.9
Toothache				
Yes	0	0	0	0
No	133	100.0	133	100.0
Abdominal infection				
Yes	45	33.8	28	21.1
No	88	66.2	105	78.9

4.2 Results of Multivariate Analysis

Multivariate analysis was used to identify variables that affect the incidence of bacteremia and those that most strongly influenced it. The multivariate analysis used was Logistic Regression. If the p-value in this analysis was less than 0.05, then this variable had a statistically significant effect on the incidence of bacteremia. The multivariate analysis used was Logistic Regression, and the results are shown in Table 2.

Table 2. Multivariate test results

Variables	p	OR	95% C.I. for EXP	
			Lower	Upper
Sex	0.020	1.940	1.110	3.394
Age	0.001	2.869	1.649	4.989
Abdominal Infection	0.016	2.289	1.165	4.498

Based on the results of the above analysis, the following conclusions can be drawn:

1. Sex had an effect on the incidence of bacteremia ($p = 0.02$). The OR was 1.94, indicating that females were 1.94 times more likely to develop bacteremia than males.
2. Age affected the incidence of bacte with ($p = 0.001$). The OR was 2.87, indicating that those aged less than 45.5 years were at greater risk of developing bacteremia, 2.87 times more than those aged 45.5 years or older.
3. Abdominal infection affected the incidence of bacteremia ($p = 0.016$). The OR value was 2.29, indicating that patients with abdominal pain are 2.29 times more likely to develop bacteremia than those without abdominal pain.
4. Based on the OR value, the variable with the greatest influence on the incidence of bacteremia was age. The variable with the least effect was gender.

Bacteremia occurs when bacteria are present in the blood. Asymptomatic bacteremia can develop during activities of daily living, such as brushing one's teeth, and after prompt medical treatment. Benign infections in clinically healthy individuals typically last only a short time and have no long-term effects on health. However, bacteremia can develop with a variety of clinical characteristics and is distinguished as septicemia when the immune response systems are ineffective or overburdened. Systemic Inflammatory Response Syndrome (SIRS), sepsis, septic shock, and multiple organ failure develop from untreated and clinically severe bacteremia ([Adil et al., 2022](#)).

In recent decades. Epidemiological studies have shown that the microorganisms causing bacteremia in individuals with neutropenia are. At the end of the last century, an increase in gram-positive microorganisms was observed in developed countries, resulting from the use of fluoroquinolones, increased use of intravascular catheters, and chemotherapy, which is associated with severe mucositis ([Finello et al., 2020](#)). Bacteremia is one of the most serious infectious diseases in children and has the potential to cause death. Bacteremia can be caused by various gram-negative and gram-positive microorganisms, which may manifest with or without specific sites of infection, such as pneumonia and meningitis ([Mojtahedi, Rahbarimanesh, Khedmat, & Izadi, 2018](#)).

The risk factors for bacteremia included temperatures exceeding 38.5°C , characterized by leukocytosis, elevated CRP and ALT levels, and decreased platelet, hemoglobin, and creatinine levels. Once in the hospital, all actions can be determined quickly and easily. The Sequential Organ Failure Assessment (SOFA) score can be used to define sepsis, and a score of 2 is associated with a 10% mortality rate according to the sepsis-3 criteria. Additionally, hyperlactatemia was linked to a 25.7% increased risk of death, and each rise in blood lactate levels was associated with a substantial increase in the odds of death in the hospital ([D'Onofrio et al., 2021](#)).

Patients with bacteremia were older than those without bacteremia (66.7 ± 16.8 years vs. 59.7 ± 17.9 years, $p = 0.008$). Univariate analysis revealed that several demographic and clinical characteristics were significantly associated with an increased risk of developing bacteremia. These included past episodes of cellulitis, the presence of fever during cellulitis and prior to blood sampling, the absence of pre-culture antibiotic therapy, symptoms lasting fewer than 2 days, a diagnostic temperature greater than 38°C , and antecedent edema of the affected limb. None of the examined comorbidities alone was associated with a higher risk of bacteremia; however, patients with bacteremia were more likely to have two or more comorbidities ([Peralta et al., 2006](#)). One of the most fatal oncological crises, with a mortality rate of up to 50%, is bacteremia caused by neutropenia and fever associated with chemotherapy. Therefore, within 1 h of symptom onset, presumed broad-spectrum antibiotic treatment

is recommended for all hospitalized febrile patients undergoing chemotherapy. However, bacteremia is observed in less than 25% of individuals. Risks of receiving antibiotics include colitis caused by *Clostridium difficile* ([Kelly et al., 2018](#)).

Sources of bacteremia were grouped into three categories based on the risk of death: low (10%), medium (10–20%), and high (>20%). The duration of bacteremia was determined based on the number of days between the first and last positive blood cultures for *S. aureus*. Patients with clinical success and no need for repeat blood cultures were labeled as having 1-day bacteremia. Clinical success was defined as the return of the white blood cell count, vital signs, and the patient's subjective well-being to the normal range. *Staphylococcus aureus* in hospitals. The first positive blood culture 48 h or more after the date of admission was used to diagnose bacteremia. Within 48 h of SAB commencement, a non-*S. aureus* concomitant infection with *S. aureus* was identified as concurrently infected.

The main targeted therapy recommended for a long time is SAB therapy. *S. aureus* infection in distant foci that are physically associated with the relevant source is believed to have metastasized. The probability of death within 30 days of a positive *S. aureus* blood culture was calculated by examining the patient's medical records ([Minejima et al., 2020](#)). A cohort of Medicare patients admitted to the United States was the subject of a study aimed at determining whether bacteremia at the time of Debridement, Antibiotics, and Implant Retention for the treatment of Prosthetic Joint Infection (PJI) was associated with higher reinfection costs. At 90 days, the DAIR failure rate was 49.5% in patients with bacteremia and 35.1% in patients without ([Babatunde et al., 2022](#)). At two years, the failure rate in the bacteremia cohort increased to 67.4%, compared to 47.7% in the group without bacteremia ([Rosas et al., 2022](#)).

A study in Spain showed that the dominant microorganism in bacteremia was gram-negative bacteria, followed by gram-positive cocci (especially *Enterococcus* spp.). Similar percentages have been reported by other authors. A study by de Saint et al. found that gram-negative bacteria were the most frequently occurring microorganisms, with the majority of species belonging to *Enterococcus* spp. The incidence of *Enterococcus* spp. was 29%, followed by *Candida* spp. at 20% ([Sante, Lecuona, Jaime, & Arias, 2019](#)). A total of 913 isolates, including 92 distinct species, were assessed. *Staphylococcus aureus* (136/913, 14.9%) and *Staphylococcus epidermidis* (238/913, 26.1%) were the most frequently observed bacteria. Of the *S. aureus* isolates, 60.3% were methicillin-resistant. A total of 236 patients were included in the risk factor analyses. *S. epidermidis* is more commonly associated with prematurity, previous antibiotic use, intubation, and ventilation. Patients with dermatitis/eczema and those who have recently been hospitalized are statistically more likely to have *S. aureus* ([Stover et al., 2021](#)).

In recent years, studies have shown that nosocomial bloodstream infections and bacteremia are increasingly linked to enterococci. Since the emergence of vancomycin-resistant enterococci, enterococcal infections have resurged ([Kerimov, Mustaev, Lavrenova, & Romanov](#)). Increased mortality, longer Length of Stay (LOS), and higher hospital expenses have all been linked to VRE bacteremia. Various infection control techniques should be considered to reduce the spread of VRE, given the significant financial losses associated with it ([Cheah et al., 2013](#)). Infectious bacteria enter the bloodstream by directly invading a blood vessel to reach the lymphatic vessels that drain the focal point of the infection (such as an abscess) or by using vascular tools such as catheter needles. Additionally, it may occur for unknown reasons, as seen in some instances of community-acquired *S. aureus* bacteremia. The spleen is the primary immunological organ responsible for combating infections that enter the bloodstream. To improve the physiological characteristics of blood arteries, sterilization and removal of live germs are performed throughout the bloodstream and at the initial infection site. Maintaining cellular oxygenation by supporting organ perfusion is the goal of treatment for individuals with bacteremia or sepsis ([Franco-Paredes, 2016](#)).

Bacteremia, which accounts for 0.36% of all infectious diseases, is an important cause of increased morbidity, mortality, and hospital costs. The incidence of bacteremia in the general population increased from 83 to 240 cases per 100,000 individuals between 1979 and 2002 ([Hernández-Roca et al., 2013](#)). The incidence of *Staphylococcus Aureus* Bacteriuria (SABU) ranges from 0.8% to 4.3% and can be

associated with asymptomatic colonization. Catheter-related urinary tract infections can spread to the bloodstream, resulting in *S. aureus* bacteremia. The rate of Staphylococcus Aureus Bacteremia in patients with Staphylococcus aureus bacteriuria ranges from 9% to 17.2%. Staphylococcus aureus bacteremia can evolve into Staphylococcus aureus bacteriuria and vice versa. Staphylococcal Aureus bacteremia, when it occurs simultaneously, is an indicator that the disease condition will become severe ([Schuler, Froböse, & Schaumburg, 2020](#)).

Among the causes of bacteremia are Citrobacter species, which belong to the group of facultative, anaerobic, gram-negative bacilli in the family Enterobacteriaceae. The spread of bacteremia in water, soil, food, and the intestines of animals and humans is known as an environmental pollutant or low-virulence invader. Bacteremia can also cause a spectrum of infections involving the urinary tract, liver, bile ducts, peritoneum, intestines, bones, respiratory tract, endocardium, wounds, soft tissues, meninges, and bloodstream. Citrobacter species accounted for 0.8% of all species. Gram-negative infections, as reported in one large observational study, account for approximately 3-6% of isolates from Enterobacteriaceae in hospitals ([Liu et al., 2018](#)).

Research on the etiology of bacteremia in COVID-positive and non-COVID patients has shown that COVID-positive patients experience bacteremia caused mainly by healthcare-associated organisms, such as coagulase-negative Staphylococcus species and Candida spp., and community-acquired pathogenic microorganisms ([Bayo, Ruíz, Hijazo, & Usón, 2022](#)). There are several nosocomial infections caused by Stenotrophomonas maltophilia, with pneumonia, bacteremia, endocarditis, infections of the eyes, urinary tract, bones and joints, skin and soft tissues, and gastrointestinal infections being the most prevalent clinical presentations. In critically ill and immunosuppressed individuals, it can occasionally be linked to septic shock. The treatment of *S. maltophilia* infections is a management issue that requires special consideration. Owing to the inherent resistance of *S. maltophilia* to many currently available broad-spectrum antibiotics, appropriate antimicrobial therapy is frequently delayed. *S. maltophilia* has a significant mortality rate in children with bacteremia, ranging from 6% to 40% ([Büyükcem et al., 2020](#)).

Owing to the immunosuppression caused by treatment, infection is one of the major causes of therapy-related morbidity and mortality in children with acute lymphoblastic leukemia. Bacteremia was identified as the most prevalent microbiological infection in this investigation. The induction phase of therapy is when infections are most prevalent, and severe infections can harm the end organs. There is evidence that the lipopolysaccharides of gram-negative bacteria, or endotoxins, which mimic the systemic effects of infection in experimental animals, predispose them to prednisone-induced osteonecrosis in animal models ([Finch et al., 2019](#)).

Complications and prolonged hospitalization are the main causes of bacteremia. Additionally, they continue to be a significant contributor to the rise in morbidity and mortality. The major cause of local death is still infection secondary to burns, and the mortality rate remains very high. Immune alterations that occur under these circumstances favor the bacteria that cause infection. Colonization can occur in hospitalized patients and involves multidrug-resistant germs. The most frequent culprits are Staphylococcus aureus, Pseudomonas aeruginosa, and Enterobacteriaceae, respectively. Bacteremia is typically caused by the invasion of microorganisms in the skin, bacteria that grow during surgical debridement, bacteria that colonize central venous lines, urinary tract infections, or bacteria that travel from the respiratory tract ([Basilico, García, & Pintos, 2021](#)).

One case of bacteremia occurred in a 71-year-old male patient with stage IV colonic adenocarcinoma with metastases to the brain and right adrenal gland. The patient was undergoing radiotherapy and awaiting immunological treatment for catarrhal symptoms. The patient was admitted to the emergency room because of general weakness, anorexia, and intense asthenia. On physical examination, the patient showed a poor clinical situation, sweating, hypothermia, poor perfusion, hypotension (70/40 mmHg), and was hemodynamically unstable. The patient was diagnosed with bilateral pneumonia and 80% oxygen saturation and was administered oxygen therapy ([Lepe-Balsalobre, Rubio-Sánchez, & Cabra-Rodríguez, 2021](#)). Penicillin-susceptible Streptococcus pneumoniae is the most common etiology of

Community-acquired Pneumonia bacteremia, and treatment is with antibiotics. Cephalosporins are the most commonly used drugs. Our findings are similar to those reported by [Fritz et al. \(2019\)](#), who showed that most pathogens recovered in children with bacteremia and CAP were penicillin-susceptible.

5. Conclusions

5.1 Conclusion

This study identified 133 cases of bacteremia during the study period, with several variables showing significant associations. Age emerged as the strongest predictor ($p = 0.001$; OR = 2.87), followed by clinical symptoms, including vomiting ($p = 0.003$; OR = 2.33), abdominal pain ($p = 0.016$; OR = 2.29), and fever ($p = 0.02$; OR = 1.94). These findings indicate that both demographic factors and specific clinical presentations play critical roles in the occurrence of bacteremia, with older patients and those presenting with gastrointestinal-related symptoms being at higher risk.

The practical contribution of this study lies in providing evidence-based indicators that can support early risk identification in clinical settings. By recognizing age and key symptoms, particularly fever, vomiting, and abdominal pain, as significant predictors, healthcare providers can prioritize high-risk patients for closer monitoring, early diagnostic testing (such as blood cultures), and prompt intervention. Furthermore, the strong association with abdominal symptoms underscores the need to improve the detection and management of underlying infections as part of hospital infection control strategies. These findings offer actionable insights for clinicians to enhance early detection, optimize patient management, and reduce the incidence and severity of bacteremia in hospitalized patients.

These findings emphasize the importance of integrating risk-based screening into routine clinical assessments, particularly for older patients and those presenting with key symptoms such as fever, vomiting, and abdominal pain. For hospitals, the results highlight the need to strengthen infection control protocols, improve clinical surveillance systems, and ensure timely diagnostic support for early bacteremia detection. For policymakers, this study provides evidence to support the development of standardized guidelines and resource allocation strategies aimed at improving infection prevention and control, particularly in secondary-level healthcare facilities. Collectively, these findings reinforce the importance of a systematic and evidence-based approach to reduce the burden of bacteremia in hospital settings.

5.2 Research Limitations

This research was conducted at only one hospital, namely, PKU Hospital; therefore, the results may not be generalizable to patient populations in other hospitals with different patient characteristics, service systems, or epidemiological conditions.

5.3 Suggestions and Directions for Future Research

Future studies are recommended to expand the scope of research by involving multiple hospitals or healthcare institutions to obtain more comprehensive and generalizable findings on the prevalence and risk factors of bacteremia. Conducting multicenter studies across different hospitals with varying patient characteristics, healthcare systems, and epidemiological conditions would provide a broader understanding of bacteremia patterns and improve the external validity of our findings. Future research should include a larger sample and longer observation period to capture a more diverse range of clinical cases and trends over time. Researchers are also encouraged to incorporate additional variables that may influence the occurrence of bacteremia, such as comorbidities, the use of invasive medical devices, antibiotic exposure, and length of hospitalization. By including these variables, future studies may provide a more comprehensive analysis of the determinants of bacteremia and support the development of more effective prevention and infection-control strategies in healthcare settings.

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Author Contributions

KK Conceptualization, Methodology, Data Analysis, And Writing - Initial Draft, FAG Data Analysis, EL Supervision, AR Writing - Initial Draft, Writing - Review & Editing

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