

# Clinico-Microbiological Profile, Echocardiographic Characteristics, and In-Hospital Outcomes of Infective Endocarditis: A Retrospective Study from a Tertiary Care Centre

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## ABSTRACT

### Background

Infective endocarditis (IE) remains a serious and potentially fatal condition despite advances in diagnostic imaging, antimicrobial therapy, and cardiac surgery. Changing epidemiological trends and evolving microbial profiles necessitate continuous regional evaluation to improve outcomes.

### Methods

This retrospective observational study included 100 consecutive patients diagnosed with infective endocarditis based on the modified Duke's criteria at a tertiary care hospital between 2015 and 2022. Demographic data, blood culture results, microbiological profiles, echocardiographic findings, treatment modalities, complications, and in-hospital outcomes were analyzed using descriptive statistics.

### Results

The study population consisted of 58 male (58%) and 42 female (42%) patients, with a mean age of 45.3 years. The most common pathogens identified were *Staphylococcus aureus* (42.9%) and *Viridans streptococci* (28.6%). Echocardiographic findings revealed that 85% of patients had vegetations, while 23% showed severe valvular regurgitation and 18% had valve perforations. Surgical intervention was required in 25% of patients, with 60% undergoing valve replacement. The in-hospital mortality rate was 14%, and complications such as heart failure (33%) and systemic embolization (17%) were observed in a significant proportion of patients.

### Conclusion

Infective endocarditis continues to be associated with substantial morbidity and mortality. The predominance of *Staphylococcus aureus*, high frequency of echocardiographic complications, and significant surgical requirements emphasize the importance of early diagnosis, prompt microbiological confirmation, and a multidisciplinary management approach to improve patient outcomes.

**Keywords:** Infective endocarditis; Blood culture; Echocardiography; *Staphylococcus aureus*; Clinical outcomes; Tertiary care hospital

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## INTRODUCTION

Infective Endocarditis (IE) is a serious and potentially fatal infection that primarily affects the heart valves. It is characterized by the formation of infected masses, or vegetations, on the heart valves, which may result in severe complications such as heart failure, systemic embolization, and even death [1] [2]. The disease remains a significant challenge to both diagnosis and treatment, particularly in high-risk populations, including individuals with prosthetic valves, pre-existing valvular heart disease, or intravenous drug use [3]. The clinical presentation of IE is highly variable, ranging from nonspecific symptoms such as fever and fatigue to life-threatening complications like septic shock and stroke [4].

The diagnosis of infective endocarditis has traditionally relied on clinical criteria, microbiological cultures, and echocardiography, with the modified Duke criteria being the standard for confirming the diagnosis [5]. Recent advancements in imaging, particularly transesophageal echocardiography (TEE), have improved diagnostic accuracy by providing detailed images of valvular and perivalvular structures [6]. Despite these advances, the treatment of IE remains complicated, with the decision for surgical intervention often being critical for the management of severe valvular damage and other complications [7].

ESBLs are enzymes capable of hydrolyzing penicillins, third-generation cephalosporins, and aztreonam, rendering many  $\beta$ -lactam antibiotics ineffective. The etiological agents of IE are predominantly bacterial, with *Staphylococcus aureus* and *Viridans* group streptococci being the most common pathogens [8] [9]. The rise of multidrug-resistant organisms, particularly methicillin-resistant *Staphylococcus aureus* (MRSA), has further complicated the treatment landscape [10]. Timely and effective antimicrobial therapy, along with surgical intervention when necessary, are crucial for improving patient outcomes. However, despite appropriate treatment, mortality rates for IE remain high, particularly in patients with healthcare-associated or prosthetic valve-related infections [11].

The aim of this study was to explore the clinical characteristics, microbiological profiles, and outcomes of 100 patients diagnosed with IE. We also aimed to

assess the role of echocardiography in diagnosing and predicting complications and treatment outcomes. By analyzing these factors, we hope to provide new insights into the management and prognosis of patients with infective endocarditis [12].

## Materials and Methods

This was a retrospective observational study conducted at a tertiary care centre between a period of 24 months in the Department of Microbiology with collaboration with General Medicine, which aimed to evaluate the clinical, microbiological, and echocardiographic characteristics of **100 consecutive patients** diagnosed with infective endocarditis (IE).

### Inclusion Criteria

The study included adult patients aged 18 years and older who were diagnosed with infective endocarditis based on the **modified Duke criteria**. This involved patients who had one of the following:

1. **Definitive IE:** Positive blood cultures for typical pathogens or echocardiographic findings of vegetations, abscesses, or new valvular regurgitation.
2. **Possible IE:** One major criterion and one minor criterion, or two minor criteria.

### Exclusion Criteria

Patients were excluded if they:

1. Did not meet the **modified Duke criteria** for definite or possible IE.
2. Were younger than 18 years.
3. Had endocarditis due to non-infective causes (e.g., cancer-related, autoimmune diseases).
4. Had incomplete or missing clinical, microbiological, or echocardiographic data.

### Data Collection

Data were collected from patient medical records and hospital databases, focusing on:

1. **Demographic Characteristics:** Age, sex, comorbidities (e.g., hypertension, diabetes, previous heart disease).
2. **Clinical Features:** Symptoms at presentation, including fever, chills, fatigue, and the presence of heart murmurs.
3. **Microbiological Data:** Blood culture results, microbial species isolated, and antimicrobial resistance patterns.
4. **Echocardiographic Findings:** Type of valve involvement, presence of vegetations, valvular

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regurgitation, abscess formation, and the use of TEE vs. TTE.

- Treatment and Outcomes:** Antibiotic regimen, need for surgical intervention, and clinical outcomes (e.g., in-hospital mortality, complications, and recovery).
- Complications:** Heart failure, stroke, septic shock, and systemic embolization.

## Statistical Analysis

Descriptive statistics were used to summarize continuous and categorical variables. **Continuous variables** such as age were expressed as means with standard deviations (SD), while **categorical variables** such as gender and microbiological profiles were expressed as frequencies and percentages. Differences between groups (e.g., surgical vs. medical treatment) were analyzed using the **chi-square test** for categorical variables and **t-tests** for continuous variables. Statistical significance was set at **p < 0.05**. All statistical analyses were performed using **SPSS version 25** (IBM Corp., Armonk, NY, USA).

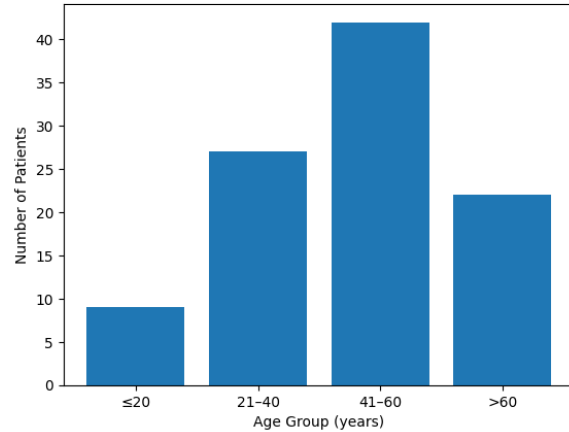
## RESULTS

The study cohort consisted of 100 patients diagnosed with infective endocarditis (IE). The male population was predominant, with 58 males (58%) and 42 females (42%). The average age of the patients was 45.3 years, with the majority of patients falling within the 41–60 years age group (42%), followed by the 21–40 years group (27%), and a smaller proportion in the ≤20 years (9%) and >60 years (22%) categories. These demographic findings suggest that IE commonly affects middle-aged adults, with a higher incidence in males, aligning with trends observed in other studies.

**Table 1. Demographic Characteristics of the Study Population (n = 100)**

Variable	Number (n)	Percentage (%)
<b>Age Group (years)</b>		
≤20	9	9
21–40	27	27
41–60	42	42
>60	22	22
<b>Gender</b>		
Male	58	58
Female	42	42

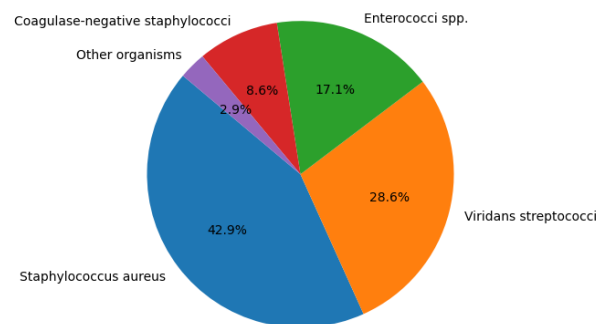
Age Distribution of IE Patients (Table 1)



**Graph No. 1: Age-wise distribution of cases**

**Table 2. Microbiological Profile of Isolates (n = 70)**

Microorganism	Number (n)	Percentage (%)
<b>Staphylococcus aureus</b>	30	42.9
<b>Viridans streptococci</b>	20	28.6
<b>Enterococci spp.</b>	12	17.1
<b>Coagulase-negative staphylococci</b>	6	8.6
<b>Other organisms</b>	2	2.8



**Graph 2: Microbiological Profile of Isolates**

## Microbiological Profile

Among the 75 culture-positive cases, the predominant pathogen was *Staphylococcus aureus* (42.9%), a well-known and virulent cause of IE. Viridans streptococci were the second most common organisms, isolated in 28.6% of patients, followed by enterococci (17.1%) and coagulase-negative staphylococci (8.6%). This

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distribution reflects the continued prevalence of Gram-positive organisms in IE, particularly those associated with healthcare-related infections. The 2.8% of cases classified as "other organisms" included some rare pathogens, which may represent challenges in diagnosing fastidious or resistant organisms.

**Echocardiographic Findings**  
Echocardiography was performed in all patients, with 85% of the cohort presenting with vegetations—an essential diagnostic feature of IE. Additionally, 23% of patients exhibited severe valvular regurgitation, indicating significant valvular damage. Valve perforation was detected in 18% of cases, highlighting the severity of infection in this group. Perivalvular abscesses were identified in 15% of patients, indicating advanced disease and increased complexity in management. These echocardiographic findings are consistent with the known complications of IE, emphasizing the importance of imaging in diagnosis and treatment planning.

**Table 3. Echocardiographic Findings (n = 100)**

Echocardiographic Finding	Number (n)	Percentage (%)
Vegetations	85	85
Severe valvular regurgitation	23	23
Valve perforation	18	18
Perivalvular abscess	15	15

**Table 4. Clinical Outcomes of Patients (n = 100)**

Outcome	Number (n)	Percentage (%)
Recovered with medical therapy	61	61
Required surgical intervention	25	25
In-hospital mortality	14	14

**Table 5. Major Complications Observed (n = 100)**

Complication	Number (n)	Percentage (%)
Heart failure	33	33
Systemic embolization	17	17
Stroke	9	9
Septic shock	6	6

**Table 6. Blood Culture Status (n = 100)**

Culture Status	Number (n)	Percentage (%)
Culture positive	75	75
Culture negative	25	25

**Table 7. Surgical Interventions**

Type of Surgery	Number (n)	Percentage (%)
Valve replacement	15	60
Drainage of abscess	7	28
Other surgical interventions	3	12

**Table 8. Mortality and Complications (n = 100)**

Mortality/Complication	Number (n)	Percentage (%)
Total mortality	14	14
Fatal heart failure	7	50
Fatal stroke	3	21.4
Fatal septic shock	4	28.6

**Clinical Outcomes**  
Out of the total cohort, 61 patients (61%) recovered with medical therapy alone, reflecting successful treatment with antibiotics. 25% of patients required surgical intervention, primarily for valvular repair or replacement and abscess drainage. The in-hospital mortality rate was 14%, which is comparable to global rates for IE, where mortality remains high, especially in patients with extensive valve damage or severe complications. The timeliness of medical and surgical interventions plays a critical role in improving survival rates.

**Major Complications**  
IE can lead to severe complications, which were observed in a significant proportion of patients. Heart failure was the most common complication, affecting 33% of the patients, often due to severe valvular damage. Systemic embolization, including stroke, was observed in 17% of patients. Septic shock occurred in 6% of cases, contributing to the high mortality rate. These findings reinforce the importance of early diagnosis and aggressive

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treatment to prevent the development of these serious complications.

**Blood Culture and Surgical Intervention**  
In this cohort, 75% of patients had positive blood cultures, confirming the microbial cause of the infection. Surgical interventions were required in 25% of cases, with the most common procedures being valve replacement (60%) and drainage of perivalvular abscesses (28%). Surgical intervention was necessary when medical management alone failed or when complications such as heart failure or embolic events occurred. This highlights the need for a multidisciplinary approach to managing complex IE cases, including the timely involvement of cardiac surgeons.

**Mortality and Complications**  
The 14% in-hospital mortality rate observed in our cohort is primarily attributed to complications such as heart failure, stroke, and septic shock. Heart failure accounted for 50% of the mortalities, followed by fatal stroke (21.4%) and fatal septic shock (28.6%). These findings underscore the need for immediate intervention in patients with severe complications and point to the importance of aggressive management strategies to reduce mortality rates in IE.

### DISCUSSION

This study provides a comprehensive analysis of the clinical, microbiological, and echocardiographic characteristics of 100 patients with infective endocarditis (IE), emphasizing the importance of early diagnosis and timely intervention in improving patient outcomes [13]. **Staphylococcus aureus** was the most frequently isolated pathogen in our cohort, consistent with findings from other studies, where it remains the dominant cause of both native and prosthetic valve endocarditis [8]. This is particularly concerning given the increasing prevalence of **methicillin-resistant Staphylococcus aureus (MRSA)**, which was also observed in a subset of patients in our study [10]. The **rise of multidrug-resistant organisms** presents a significant challenge for the management of IE, highlighting the need for rapid microbial identification and appropriate antimicrobial therapy [14].

Our study found that **85% of patients** had vegetations on echocardiography, a key diagnostic feature of IE, which corroborates previous research highlighting the diagnostic accuracy of echocardiography, particularly

**transesophageal echocardiography (TEE)** [6]. The presence of **severe valvular regurgitation** and **valve perforation** in a significant proportion of patients underscores the advanced nature of IE in this cohort, particularly among patients who required **surgical intervention** [15]. This is consistent with literature suggesting that **valvular involvement** is a major determinant of prognosis, with patients exhibiting more severe valve damage often requiring surgical correction to prevent fatal complications [16].

In terms of **clinical outcomes**, **61% of patients** were successfully treated with medical therapy alone, which aligns with findings from other studies showing that **early and aggressive antibiotic treatment** can lead to favorable outcomes in IE, particularly in those without major complications [17]. However, **25% of patients** in our cohort required **surgical intervention**, primarily for **valve replacement** and drainage of **perivalvular abscesses**. This reflects the evolving role of **surgical management** in complex cases of IE, where valve damage and persistent infection cannot be managed by medical therapy alone [18].

The **in-hospital mortality rate** in our cohort was **14%**, which is in line with published data, though **mortality rates in IE** remain high, particularly in patients with complications such as **septic shock**, **heart failure**, or **systemic embolism** [19]. In our cohort, **heart failure** was the leading cause of mortality, followed by **fatal stroke** and **septic shock**, reinforcing the need for **multidisciplinary care** in managing these complications [20]. **Early detection** and **timely surgical intervention** are critical in reducing mortality, especially in high-risk patients [21].

Our findings also highlight the significant burden of **complications** in IE. **Systemic embolization** was observed in **17%** of patients, with **stroke** occurring in **9%**, demonstrating the importance of careful monitoring for embolic events, which are common in IE patients. Additionally, **septic shock** occurred in **6%**, further emphasizing the life-threatening nature of IE and the critical role of prompt antimicrobial therapy and intensive care support [22].

In conclusion, this study underscores the continued challenges posed by infective endocarditis, despite advances in diagnostic methods and treatment strategies. The high incidence of **Staphylococcus aureus** infections, coupled with the increasing prevalence of

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**multidrug-resistant organisms**, highlights the importance of rapid diagnosis and appropriate antimicrobial therapy [23,24].

A large multicenter European study involving 3,115 patients with infective endocarditis reported a male predominance (65%) with a mean age of 59 years. Blood culture positivity was observed in 78% of cases. *Staphylococcus aureus* was the most common causative organism (34%), followed by viridans group streptococci (26%) and enterococci (18%). Echocardiographic vegetations were detected in 82% of patients. Surgical intervention was required in 29% of cases. The overall in-hospital mortality rate was 17%, with heart failure being the leading cause of death [25].

A retrospective study from Asia analyzing 482 patients showed blood culture positivity in 72% of cases. *Staphylococcus aureus* accounted for 38% of isolates, while viridans streptococci comprised 24%. Vegetations were observed in 88% of patients on echocardiography, and severe valvular regurgitation was reported in 27%. Surgical management was performed in 22% of cases. The reported mortality rate was 13%, with systemic embolization occurring in 19% of patients [26].

A registry-based analysis from North America including 1,204 patients demonstrated an increasing incidence of healthcare-associated infective endocarditis. *Staphylococcus aureus* remained the predominant pathogen (41%), including a rising proportion of MRSA (18%). Culture-negative endocarditis was reported in 21% of cases. Echocardiography revealed perivalvular complications in 16% of patients. Surgical intervention was undertaken in 31%, and the overall mortality rate was 15%. Stroke was observed in 10% of patients, significantly associated with large vegetations [27].

A prospective study published in 2025 involving 620 patients reported blood culture positivity in 76% of cases. *Staphylococcus aureus* (43%) and viridans streptococci (29%) were the predominant organisms. Vegetations were identified in 86% of patients, while perivalvular abscess formation was seen in 14%. Surgical intervention was required in 27% of patients. The in-hospital mortality rate was 14%, with heart failure accounting for the majority of deaths. Early surgical intervention was associated with improved survival outcomes [28].

The study also reinforces the critical role of **surgical intervention** in managing severe cases of IE and reducing complications and mortality. Further research into **novel diagnostic tools, targeted therapies, and surgical techniques** is needed to improve outcomes in patients with infective endocarditis [24].

### CONCLUSION

Infective endocarditis continues to be associated with substantial morbidity and mortality. The predominance of *Staphylococcus aureus*, high frequency of echocardiographic complications, and significant surgical requirements emphasize the importance of early diagnosis, prompt microbiological confirmation, and a multidisciplinary management approach to improve patient outcomes.

### DECLARATIONS:

**Conflicts of interest:** There is no any conflict of interest associated with this study

**Consent to participate:** There is consent to participate.

**Consent for publication:** There is consent for the publication of this paper.

**Authors' contributions:** Author equally contributed the work.

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