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The clinical, microbiological, and demographic aspects of *Burkholderia* infections: insights from a tertiary healthcare setting

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ABSTRACT

Background and objectives. Optimal management requires an understanding of *Burkholderia* infections demographic, clinical, microbiological, and antibiotic features. This study aims to improve treatment and infection control strategies by investigating the clinical profiles and antibiotic susceptibilies of *Burkholderia* infections in a tertiary care context.

Material and methods. A retrospective analysis of 48 individuals with *Burkholderia* infections was carried out in a tertiary care environment. We gathered and analyzed data on antimicrobial susceptibility, clinical presentation, microbiological identification, and demographic features.

Results. The mean age of the participants was 49.27 years, and their gender distribution was equal. Diabetes, heart disease, and hypertension are common comorbidities. The most typical symptoms were fever and cough, with infections varying in severity from minor to severe. *Burkholderia* was predominantly found in urine, blood, and respiratory secretions. Testing for antibiotic susceptibility showed inconsistent findings; some drugs, including ceftazidime and meropenem, were more successful than others.

Conclusion. The research highlights the broad demographics impact of *Burkholderia* infections, in addition to their acute and occasionally fatal characteristics. It highlights how important it is to treat every patient differently, accounting for comorbidities and the severity of symptoms. The results emphasize how much more study is required to improve treatment options and learn more about the origins of *Burkholderia* infections.

Keywords: *Burkholderia* infections, antimicrobial susceptibility, respiratory symptoms, healthcare-associated infections, antibiotic resistance

INTRODUCTION

Burkholderia cepacia complex (Bcc) is a group of Gram-negative bacilli that are of significant concern in healthcare settings, especially within tertiary care centers where immunocompromised individuals are at heightened risk [1]. The Bcc and other *Burkholderia* species are notoriously known for their inherent resistance to multiple antibiotics and their ability to cause severe infections, particularly in patients with cystic fibrosis or chronic granulomatous disease [2]. The clinical manifestation of *Burkholderia* infections can range from asymptomatic colonization to severe, life-threatening pneumonia and sepsis, rendering their identification and the understanding of their antimicrobial susceptibility patterns critical [3].

The genus *Burkholderia* encompasses over 60 species, of which *B. cepacia, B. pseudomallei,* and *B. mallei* are the most clinically significant due to their pathogenic potential and intrinsic multidrug resistance mechanisms [4]. The difficulty in treating *Burkholderia* infections lies not only in their resistance to common antibiotics but also in their ability to form biofilms and evade the host's immune responses [5]. In tertiary care settings, where patients

often receive complex treatments and invasive procedures, the management of infections must be prompt and evidence-based to prevent outbreaks and ensure patient safety [6]. In such environments, *Burkholderia* species pose a unique challenge due to their high-level resistance to many of the antimicrobials conventionally used in hospitals [7].

Recent data suggest that the epidemiology of Burkholderia infections is evolving, with a noted increase in hospital-acquired infections. Moreover, the global spread of these organisms has been facilitated by the movement of patients between healthcare facilities, emphasizing the need for stringent infection control measures and robust antimicrobial stewardship programs [8]. The clinical impact of *Burkholderia* species is significant, as these infections are associated with increased morbidity and mortality rates. This is particularly true in vulnerable populations, such as patients with underlying lung diseases, where Bcc infections can lead to rapid deterioration and a decline in lung function [9]. Furthermore, the presence of *Burkholderia* species in healthcare settings has been associated with longer hospital stays, increased healthcare costs, and a substantial burden on resources, underscoring the importance of early detection and effective management strategies [10].

In the context of a tertiary care setting, the study of the antimicrobial profile of *Burkholderia* species is critical. It informs the selection of appropriate empirical therapy, guides the formulation of infection control policies, and assists in the surveillance of antibiotic resistance trends. This, in turn, aids in the optimization of patient outcomes and the preservation of antimicrobial efficacy [11]. Recent advances in molecular diagnostics have improved the identification and speciation of *Burkholderia,* although challenges persist due to the extensive diversity within the genus. Molecular methods have also advanced the understanding of the genetic basis for antibiotic resistance among these bacteria, facilitating the development of novel therapeutic strategies [12]. The aim of the study is to delineate the clinical profiles of *Burkholderia* infections in a tertiary care setting and to assess the antimicrobial susceptibilities of the isolates, in order to inform the selection of appropriate empirical therapy, guide infection control policies, and contributes to the surveillance of antibiotic resistance trends.

MATERIALS AND METHODS

Study design and setting

This study was designed as a cross-sectional observational study, conducted in a tertiary healthcare setting. Our research was focused on patients admitted to Saveetha Medical College, a comprehensive care facility with a high influx of infectious disease cases, between January and June 2023.

Sample selection

Inclusion Criteria: Patients included in the study were those with laboratory-confirmed *Burkholderia* species infection, as determined by culture and biochemical tests. Ages ranged from 18 to 75 years, encompassing a diverse demographic.

Exclusion Criteria: Patients were excluded if they had received antimicrobial therapy in the two weeks prior to admission or had other co-existing infections that could confound the study results.

Sampling Method: A total of 48 patients were selected through a systematic random sampling method from the pool of eligible patients, ensuring a representative sample of the patient population treated for Burkholderia infections during the study period.

Data collection

Patient Demographics: We collected comprehensive demographic data including age, gender, underlying comorbidities, and history of hospitalizations.

Clinical Data: Clinical information such as presenting symptoms, duration of symptoms before hospitalization, and severity of infection at admission was documented.

Microbiological Data: *Burkholderia* species were identified from clinical specimens including blood, urine, and respiratory secretions. Standard culture methods followed by biochemical testing were employed for accurate identification.

Antimicrobial susceptibility testing

Methods: The antimicrobial susceptibility of the Burkholderia isolates was determined using the disk diffusion method.

Antibiotics Tested: A range of antibiotics commonly used to treat *Burkholderia* infections was tested, including ceftazidime, meropenem, and trimethoprim-sulfamethoxazole.

Statistical Methods: Descriptive statistics were used to summarize demographic and clinical data. Inferential statistics, including Chi-square and t-tests, were employed to identify any significant associations or differences in outcomes. The statistical analysis was conducted using SPSS Version 26.0.

RESULTS

Table 1 shows, the average age of the patients in the study was 49.27 years, with a standard deviation of 10.62 years. This suggests that the patient population with Burkholderia infections in the health-

care facility during the study period spans a wide age range. The study had an equal distribution of gender, with 24 male (50%) and 24 female (50%) patients. This indicates that *Burkholderia* infections do not appear to have a significant gender bias among this group of patients. Among the patients, hypertension was the most common underlying comorbidity, observed in 31.25% of cases. This highlights the potential association between hypertension and *Burkholderia* infections in this patient population.

TABLE 1. Demographic characteristics of 48 patients with *Burkholderia* infections in a tertiary healthcare setting

Category	Data
Mean Age (years)	49.27
Standard Deviation of Age	10.62
Gender Distribution	
Male	24 (50%)
Female	24 (50%)
Underlying Comorbidities	
Hypertension	15 (31.25%)
Diabetes	12 (25%)
Asthma	10 (20.83%)
Heart Disease	12 (25%)
Obesity	7 (14.58%)
None	16 (33.33%)
History of Hospitalizations	
Yes	21 (43.75%)
No	27 (56.25%)

Diabetes and heart disease were also relatively common, with 25% of patients having each of these conditions. Asthma was present in approximately 20.83% of patients, indicating that it is a notable comorbidity in this context. Obesity, while less prevalent, was still observed in 14.58% of patients. A significant proportion (33.33%) of patients had no documented underlying comorbidities. This suggests that *Burkholderia* infections can affect individuals without pre-existing health conditions.

Table 2 shows that the substantial portion of the patients (43.75%) had a history of hospitalizations prior to the current study. This may indicate that *Burkholderia* infections are more likely to occur in individuals with a recent history of hospitalization (Table 1).

The cumulative data for 48 patients with Burkholderia infections reveals that fever and cough are the most common presenting symptoms, affecting over half of the patients, indicating a significant respiratory involvement. Patients typically sought medical attention within 4.5 days of symptom onset, suggesting a relatively quick progression of the disease. In terms of severity at admission, the largest group of patients presented with moderate symptoms, though a substantial number exhibited either

mild or severe symptoms. This variability underscores the diverse clinical impact of *Burkholderia* infections, highlighting the need for timely diagnosis and tailored medical interventions for effective management (Table 2).

TABLE 2. Clinical data of 48 patients with *Burkholderia* Infections

Category	Data
Most Common Presenting Symptoms	
• Fever	30 patients (62.5%)
• Cough	28 patients (58.33%)
• Dyspnea (Difficulty Breathing)	20 patients (41.67%)
• Fatigue	18 patients (37.5%)
• Chest Pain	15 patients (31.25%)
• Headache	12 patients (25%)
Average Duration of Symptoms Before Hospitalization	4.5 days
Severity of Infection at Admission	
• Mild	16 patients (33.33%)
• Moderate	20 patients (41.67%)
• Severe	12 patients (25%)

Table 3, elucidates *Burkholderia* species were identified in the blood of about 42% of the cases, indicating a significant presence of the bacteria in the bloodstream, which could suggest a systemic infection. Detection in urine samples in about 31% of cases might indicate urinary tract involvement or possibly a disseminated infection affecting multiple organ systems.

The highest detection rate was in respiratory secretions (52.08%), which align with the prominent respiratory symptoms like cough and dyspnea observed in the patients. This suggests a strong respiratory tract involvement. In about 21% of cases, Burkholderia species were identified in more than one type of specimen, which could imply a widespread infection affecting multiple systems (Table 3).

TABLE 3. Microbiological identification of *Burkholderia* species from clinical specimens

Specimen Type	Number of Positive Cases	Percentage of Total Cases
Blood	20	41.67%
Urine	15	31.25%
Respiratory Secretions	25	52.08%
Multiple Specimens	10	20.83%
Total Cases	48	100%

Table 4 explains the antimicrobial susceptibility testing for *Burkholderia* isolates, covering six antibiotics, revealed varied effectiveness. Ceftazidime and Meropenem were notably effective, with the majority of the isolates showing susceptibility. To-

TABLE 4. Antimicrobial susceptibility of *Burkholderia* isolates

Antibiotic	Susceptible cases	Intermediate susceptibility	Resistant cases	Total cases tested
Ceftazidime	30	10	8	48
Meropenem	35	8	5	48
Trimethoprim-Sulfamethoxazole	25	15	8	48
Piperacillin-Tazobactam	28	12	8	48
Ciprofloxacin	22	16	10	48
Tobramycin	32	10	6	48

bramycin also demonstrated strong efficacy. In contrast, Trimethoprim-Sulfamethoxazole, Piperacillin-Tazobactam, and Ciprofloxacin exhibited a more mixed response, with a significant number of cases showing intermediate susceptibility or resistance (Table 4).

DISCUSSION

The study's demographic findings show an average age patient age of 49.27 years with a standard deviation of 10.62 years. This wide age range suggests *Burkholderia* infections affect a broad adult population. The equal gender distribution, with 24 male and 24 female patients each, indicates no significant gender bias, aligning with previous research by LiPuma [13], which suggests a similar distribution in *Burkholderia* infections, particularly in non-cystic fibrosis patients. The presence of comorbidities like hypertension (31.25%), diabetes (25%), and heart disease (25%) in this patient group is noteworthy. This association is supported by Hatcher and group [14], who pointed out that chronic illnesses might predispose individuals to bacterial infections due to compromised immunity. The occurrence of asthma in 20.83% of patients and obesity in 14.58%, along with 33.33% having no comorbidities, further indicates the diverse health backgrounds affected by this infection.

Clinical data from the study presents an interesting pattern of symptomatology and disease severity. Fever and cough were the most common symptoms, observed in 62.5% and 58.33% of patients, respectively. This high incidence of respiratory symptoms is consistent with *Burkholderia's* known respiratory involvement, as highlighted by Mahenthiralingam et al. [15]. The average duration of symptoms before hospitalization was 4.5 days, and 43.75% of patients had a history of prior hospitalizations. These findings underscore the acute nature of the infection and suggest possible healthcare-associated risks, a notion supported by Drevinek [16]. The variability in symptom severity (mild in 33.33%, moderate in 41.67%, and severe in 25%) underscores the diverse clinical presentations of *Burkholderia,* as documented by LiPuma [17].

The study's microbiological data is particularly telling. Burkholderia species were most commonly identified in respiratory secretions (52.08%), which is in line with the predominant respiratory symptoms like cough and dyspnea. Da Silva group [18] corroborate this finding, emphasizing the pathogen's respiratory tract involvement. The bacteria were also detected in blood (41.67%) and urine samples (31.25%), suggesting potential for systemic infection and urinary tract involvement or disseminated infection, as noted by Zlosnik et al. [19]. The presence of *Burkholderia* in multiple specimen types in 20.83% of cases further indicates the potential for widespread infection, affecting multiple systems.

The antimicrobial susceptibility testing reveals varying effectiveness of different antibiotics. Ceftazidime, Meropenem, and Tobramycin showed the highest effectiveness, with the majority of isolates being susceptible. This finding aligns with Rhodes and Schweizer [20], who discuss the intrinsic resistance of Burkholderia to many antibiotics and the challenges in treatment. The resistance patterns observed in the study, especially with antibiotics like Trimethoprim-Sulfamethoxazole, Piperacillin-Tazobactam, and Ciprofloxacin, highlight the necessity for careful antibiotic selection. This is in line with the Waters and Ratjen study [21], who emphasize the importance of susceptibility testing in guiding treatment for *Burkholderia* infections.

CONCLUSION

The study offers crucial insights into *Burkholderia* infections, underscoring their extensive impact across various demographics, the potential severity of the condition, and the challenges in treatment due to antibiotic resistance. It highlights the importance of taking into account patient-specific factors such as comorbidities and symptom severity for effective management. These findings enrich the current understanding of *Burkholderia* and underscore the need for further research to enhance treatment approaches and understand the disease's progression in diverse patient groups.

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