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Research Article

# SPECTRUM AND OUTCOMES OF OPPORTUNISTIC INFECTIONS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS: A HOSPITAL-BASED OBSERVATIONAL STUDY IN NORTH KARNATAKA

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**ABSTRACT**

**Objective:** Patients with type 2 diabetes mellitus (T2DM) are at increased risk for opportunistic infections due to impaired immune responses and chronic hyperglycemia. This study aimed to assess the spectrum, burden, and clinical outcomes of opportunistic infections in T2DM patients at a tertiary care hospital.

**Methods:** A hospital-based observational study was conducted from August 2024 to January 2025, involving 141 T2DM patients with infections out of a total of 440 diabetic patients who attended inpatient and outpatient services. Demographic data, infection types, glycemic control (glycosylated hemoglobin [HbA1c]), comorbidities, treatment modalities, and outcomes were analyzed. Chi-square testing was used to assess associations between infection types and sex.

**Results:** The prevalence of infections among T2DM patients was 32.04%. The majority were aged 51–60 years (70.2%), and males were slightly more affected (53.2%). Most infections occurred in patients with a diabetes duration of 6–10 years and HbA1c levels between 9 and 11%. Acute gastroenteritis (21.3%), urinary tract infections (34%), and pneumonia (10.6%) were the most common. Pneumonia showed a significant association with male sex (p=0.026). Hypertension was the most frequent comorbidity (90.7%). Overall, 89.7% of patients recovered, whereas 10.3% developed complications; no mortality was recorded. Longer hospital stays were significantly associated with poor glycemic control (HbA1c >8.5%, p=0.03).

**Conclusion:** Opportunistic infections are common in T2DM, especially among patients with longer disease duration and poor glycemic control. Early recognition and optimized diabetes management are essential for reducing infection-related complications and hospitalization.

**Keywords:** Type 2 diabetes mellitus, Opportunistic infections, Glycosylated hemoglobin, Urinary tract infection, Pneumonia, Glycemic control, Hospital outcomes, Comorbidities.

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## INTRODUCTION

Diabetes mellitus (DM) is a clinical syndrome associated with a deficiency of insulin secretion or action. It is considered one of the largest emerging threats to health in the 21st century. It is estimated that there will be 380 million persons with DM in 2025 [1]. Patients with DM have infections more often than those without DM. Some of these infections are also more likely to have a complicated course in diabetic patients than in non-diabetic patients [2]. In a prospective study of 101,293 adult hospitalized patients, 1640 episodes of bacteremia were diagnosed. Among 1000 hospitalized patients studied, 2/3 of the bacteremia cases were found in patients with DM compared to 1/3 in patients without DM (p<0.001) [3]. Disturbances in cellular innate immunity play a role in the pathogenesis of the increased prevalence of infections in DM patients. In general, a better regulation of the DM leads to an improvement of cellular function [4]. A second important mechanism is the increased adherence of the microorganism to diabetic cells. Furthermore, some microorganisms become more virulent in a high-glucose environment [5]. The risk of skin, nail, and mucous membrane infections is increased in diabetes, and diabetic foot infections are more common, challenging, and best managed by a multidisciplinary team [6]. Evidence suggests that diabetes is a risk factor for serious respiratory infections, including tuberculosis (TB), which can have atypical features. Asymptomatic bacteriuria (ASB) and pyelonephritis are common in diabetic patients, especially women. Although the role of antibiotic therapy for ASB in diabetes is uncertain, pyelonephritis should be managed carefully because of the significant risk of systemic and local complications [7]. Diabetes is a risk factor for periodontal disease, which, in turn, can worsen glycemic control. Nosocomial, especially wound, infections are more likely to develop in diabetic inpatients, and there is evidence that near-normal blood glucose levels achieved through intensive intravenous insulin therapy improve the associated morbidity and mortality [8]. Patients with DM exhibit increased susceptibility to infections due to multiple immune dysfunctions, including impaired neutrophil function, reduced antioxidant levels, and poor glycemic control [9-11]. The incidence and severity of several common infections are significantly elevated in individuals with DM, such as urinary tract infections (UTIs), pneumonia, skin and soft-tissue infections, infections caused by *Staphylococcus aureus*, and TB. In addition, diabetes is associated with a higher risk for certain uncommon and potentially life-threatening infections, including mucormycosis, emphysematous infections of the urinary tract or gallbladder, and malignant otitis externa [12,13].

Furthermore, infectious syndromes in diabetic patients often present atypically, leading to diagnostic delays and contributing to worse clinical outcomes. Several Indian studies have identified infections as a leading cause of morbidity and mortality among patients with DM, underscoring the need for early recognition and aggressive management [14-16].

Type 2 DM (T2DM) predisposes patients to a wide range of opportunistic infections due to altered immune responses. Understanding the spectrum and outcomes of these infections is critical in high-burden areas such as North Karnataka.

**Objective**

To assess the spectrum and clinical outcomes of opportunistic infections in patients with T2DM, and to know the burden of opportunistic infections in patients with T2DM.

## METHODS

This is a prospective observational study conducted over 6 months on patients attending the outpatient department (OPD) and inpatient department (IPD) of JGMM Medical College Hospital. A total of 440 patients were included in the study using a random convenience sampling method. Institutional Ethical Committee approval was taken (JGMMMCIEC/026/2024), and informed consent from the participants was also taken before we conducted the study.

**Inclusion criteria**

Patients in the age group >18 years, diagnosed with DM, who presented with opportunistic infection, and who were willing to involve in the study, were included in the study.

**Exclusion criteria**

Pregnant women, patients with known chronic renal diseases, and patients on chemotherapy were excluded from the study.

**Sample size**

Based on the OPD and IPD statistics, a total of 440 patients with DM were screened for the study. Out of 440 patients, 141 patients were found to be suffering from various types of infection, and these patients were included in the study.

**Data collection**

Patient demographics details, type and site of infection, glycosylated hemoglobin (HbA1c) levels, hospital stay duration, microbiological profile, treatment modalities, and outcomes (recovery, complications, and mortality) were recorded in a specially designed performa.

**Sample size**

Based on the OPD and IPD statistics, a total of 440 patients with diabetes mellitus were screened for the study. Out of 440 patients, 141 patients were found to be suffering with various type of infection and these patients were included in the study.

**Statistical analysis**

Descriptive statistics, Chi-square test for categorical variables, and logistic regression for outcome predictors were used. $p<0.05$ was considered statistically significant.

## RESULTS

A total of 141 T2DM patients were included in the study.

The maximum number of infections (70.2%) occurred in the age group between 51 and 60 years, which may be because of reduced immunity and longer duration of diabetes status in that age group, and male patients had more opportunistic infections compared to females (Table 1).

Infections were more common (63.2%) in patients with a 6–10-year duration of diabetes, followed by patients with diabetes for more than 10 years (24.1%). Infections were less (12.7%) in patients with diabetes, 1 year to 5 years. Infections were more (63.1%) in patients with HBA1C between 9% and 11% indicating that uncontrolled diabetics are more prone to various infections. Hypertension (90.7%) was the most frequent comorbidity in this study, followed by hepatic and cardiovascular disease.

In this study, infections were more common in patients on oral antidiabetic drugs (53.9%), in comparison to patients on insulin therapy (19.9%) (Table 2).

Acute gastroenteritis is the most common diagnosis (21.3%), affecting both genders equally. UTIs (combined) are highly prevalent, with uncomplicated UTIs more common in males and complicated UTIs more common in females. Pneumonia appears only in males, while bacterial vaginitis and cellulitis appear only in females. Overall, males account for a slightly higher proportion (53.2%) of the total diagnoses (Table 3).

**Types of infections**

- UTI (34%) – Common pathogens: *Escherichia Coli*, *Candida albicans*
- Pulmonary TB (6.4%) – Diagnosed via sputum acid-fast bacilli and

**Table 1: Age and gender distribution of study subjects**

| Parameters | Number of diabetics with infection (n=141) | Percentage |
|---|---|---|
| Age groups in years | | |
| 30–40 | 6 | 4.2 |
| 41–50 | 28 | 19.8 |
| 51–60 | 99 | 70.2 |
| >60 | 8 | 5.6 |
| Sex | | |
| Male | 75 | 53.2 |
| Female | 66 | 46.8 |

**Table 2: Duration of diabetes, comorbidity, HbA1c, and treatment of patients**

| Parameters | Number of patients (n=141) | Percentage |
|---|---|---|
| Duration of diabetes | | |
| 1–5 years | 18 | 12.7 |
| 6–10 years | 89 | 63.2 |
| >10 years | 34 | 24.1 |
| Comorbidity | | |
| Hypertension | 128 | 90.7 |
| Neurologic disease | 8 | 5.7 |
| Thyroid disease | 10 | 7.1 |
| Cardiovascular disease | 16 | 11.3 |
| Hepatic disease | 18 | 12.8 |
| Renal disease | 14 | 9.9 |
| No comorbidities | 6 | 4.6 |
| HBA1C | | |
| 6.5–9 | 36 | 25.5 |
| 9–11 | 89 | 63.1 |
| >11 | 16 | 11.3 |
| Type of treatment | | |
| Oral anti diabetic drugs | 76 | 53.9 |
| Insulin treatment | 28 | 19.9 |
| Oral anti diabetic drugs and insulin treatment | 37 | 26.2 |

HbA1c: Glycosylated hemoglobin

**Table 3: Distribution of opportunistic infection in male and female diabetic patients**

| Diagnosis | Male (%) | Female (%) | Total (%) |
|---|---|---|---|
| UTI complicated | 6.4 | 8.5 | 14.9 |
| UTI uncomplicated | 12.8 | 6.4 | 19.1 |
| Acute gastroenteritis | 10.6 | 10.6 | 21.3 |
| Diabetic foot | 2.1 | 2.1 | 4.3 |
| Bacterial vaginitis | 0 | 2.1 | 2.1 |
| Pneumonia | 10.6 | 0 | 10.6 |
| Liver disease | 4.3 | 4.3 | 8.5 |
| Cellulitis | 0 | 4.3 | 4.3 |
| Tuberculosis | 2.1 | 4.3 | 6.4 |
| Skin infection | 4.3 | 4.3 | 8.5 |
| Total | 53.2 | 46.8 | 100 |

UTI: Urinary tract infection

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- Skin/soft tissue infections (8.5%) – Mainly diabetic foot
- Fungal infections (2.1%) – vaginal candidiasis
- Pneumonia (10.6%) – Community-acquired pneumonia and hospital-acquired pneumonia variants
- Acute gastroenteritis-cholecystitis and enteritis.

Pneumonia shows a statistically significant association with sex (p=0.026, which is less than the standard significance level of 0.05). This suggests that the occurrence of pneumonia among diabetic patients differs significantly between males and females. All other infections—including UTIs (both complicated and uncomplicated), acute gastroenteritis, diabetic foot, liver disease, bacterial vaginitis, cellulitis, and TB —show no significant association with sex, as their p-values are well above 0.05 (Table 4).

In our study, a significant majority (89.7%) of patients achieved complete recovery. Complications were reported in 10.3% of cases, including the progression of foot ulcers and the development of abscesses. Importantly, no mortality was recorded in this cohort. The mean duration of hospital stay was 10.4±3.2 days. A statistically significant association was identified between longer hospital stays and poor glycemic control, particularly in patients with HbA1c levels exceeding 8.5% (p=0.03). This finding suggests that elevated HbA1c may be indicative of more severe infections or delayed recovery in this population (Table 5).

## DISCUSSION

Patients with DM experience significantly higher rates of infection compared to those without DM [17-19]. Early diagnosis and prompt, aggressive treatment of infections in this vulnerable population remain essential clinical priorities. Various components of the immune system are compromised in diabetic individuals. Leukocyte functions—including adherence, chemotaxis, and phagocytosis—are notably impaired, contributing to increased susceptibility [20,21]. Moreover, the burden of infection is considerably higher in developing countries like India compared to developed nations, reflecting disparities in health-care access, glycemic control, and infection surveillance [22].

**Table 4: Association between sex and opportunistic infection in diabetic patients**

| Diagnosis | Chi-square value (df) | p-value | Conclusion |
|---|---|---|---|
| UTI complicated | 0.039 (1) | 0.843 | No significant association |
| UTI uncomplicated | 0.171 (1) | 0.676 | No significant association |
| Acute gastroenteritis | 0.345 (1) | 0.557 | No significant association |
| Diabetic foot | 0.234 (1) | 0.629 | No significant association |
| Bacterial vaginitis | 2.374 (1) | 0.123 | No significant association |
| Pneumonia | 4.924 (1) | 0.026 | Significant association |
| Liver disease | 0.104 (1) | 0.747 | No significant association |
| Cellulitis | 2.374 (1) | 0.123 | No significant association |
| Tuberculosis | 0.508 (1) | 0.476 | No significant association |

UTI: Urinary tract infection

**Table 5: Outcome of opportunistic infection in type 2 diabetes mellitus**

| Outcomes | Value (%) |
|---|---|
| Recovery | 89.7 |
| Complications | 10.3 (including foot ulcer progression, abscess) |
| Mortality | 0 |
| Average hospital stay | 10.4±3.2 days |
| Longer stays correlated with | HbA1c>8.5 (p=0.03) |

HbA1c: Glycosylated hemoglobin

This study aimed to evaluate the spectrum and outcomes of opportunistic infections in patients with T2DM. Out of 440 patients with T2DM evaluated between August 2024 and January 2025, 141 (32.04%) experienced infections, highlighting the considerable burden of infections in this population. The study observed the highest number of cases in the fifth decade this study aligning with the findings of Kumar *et al*., who also reported a peak infection rate in middle-aged diabetics [23]. This age group typically has a longer duration of diabetes and declining immune function, contributing to susceptibility. Males (53.2%) were slightly more affected than females (46.8%) in our study, which is consistent with the results of Mohan *et al*., who observed a male predominance in diabetic infections [24]. This gender difference may be influenced by behavioral factors, delayed health-care-seeking among men, or occupational exposures.

Patients with a diabetes duration of 6–10 years exhibited the highest infection rates (63.2%). This mirrors the findings of Singh *et al*., who demonstrated a direct correlation between duration of diabetes and infection prevalence [25]. Furthermore, poor glycemic control emerged as a key risk factor, with 63.1% of infected patients having HbA1c levels between 9 and 11%. Umpierrez *et al*. reported that hyperglycemia impairs neutrophil function and cytokine response, thereby compromising host defense and increasing infection risk [26].

The most common infections in our study included acute gastroenteritis (21.3%), UTIs (34%), pneumonia (10.6%), and skin/soft-tissue infections (8.5%). This is consistent with the findings of Viswanathan *et al*., who reported high frequencies of UTI and respiratory infections among T2DM patients [27]. Geerlings and Hoepelman explained that UTIs in diabetics are linked to poor glycemic control, bladder dysfunction, and immune compromise. Notably, pneumonia was significantly more common in males (p=0.026), a novel finding warranting further exploration [28].

Hypertension was the most prevalent comorbidity (90.7%), a trend also noted by the American Diabetes Association. A higher infection rate was observed in patients managed with oral antidiabetic drugs (53.9%) compared to insulin [29]. This contrasts with findings by Rhee *et al*., who noted improved infection outcomes in insulin-treated patients, likely due to better glycemic control and more frequent monitoring [30].

A large proportion of patients (89.7%) recovered completely, with no mortality reported. Complications occurred in 10.3% of cases, primarily involving diabetic foot ulcers and abscess formation. Mean hospital stay was 10.4±3.2 days, with prolonged hospitalization significantly associated with HbA1c >8.5% (p=0.03), similar to findings by Keenan *et al*., who linked elevated HbA1c with delayed infection resolution [31].

### Limitations of the study

It was a single-center study. Lack of long-term follow-up data and possible referral bias were other limitations.

## CONCLUSION

Opportunistic infections are common in T2DM, especially among patients with longer disease duration and poor glycemic control. Early recognition and optimized diabetes management are essential for reducing infection-related complications and hospitalization. Opportunistic infections are a major cause of morbidity and mortality among T2DM patients in North Karnataka. Strengthening glycemic control, infection surveillance, and region-specific guidelines are crucial for better outcomes.

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## AUTHOR'S CONTRIBUTION

Siddaganga, Rachana Y Hebbal, Vrushali Mohite, Vijayalakshmi KP:

Study concept and design, literature search, data acquisition, analysis, interpretation of results, manuscript preparation, and manuscript editing. Rachana Y Hebbal, Vrushali Mohite, Vijayalakshmi KP: Study concept and design, data acquisition, manuscript editing, and review. Siddaganga, Rachana Y Hebbal, Vrushali Mohite: Data analysis, interpretation of results, manuscript preparation, and editing. Siddaganga, Rachana Y Hebbal, Vrushali Mohite, Vijayalakshmi KP: Manuscript preparation, editing, and review.

## CONFLICTS OF INTEREST

There are no conflicts of interest among the authors.

## FINANCIAL SUPPORT

None.

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