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Original article

DOI: https://doi.org/10.3329/jacedb.v4i2.83558

Journal of Association of Clinical Endocrinologist and Diabetologist of Bangladesh
July 2025, Vol. 4, No. 2, pp. 50-56

ISSN (Online): 2959-8176
ISSN (Print): 2958-0307

Infectious disease patterns of patients with diabetes mellitus compared to non-diabetes in a non-surgical ward of a medical college hospital

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Abstract

Background: Infection is an important cause of hospitalization among people with diabetes mellitus (DM). Existing literature exhibits a scarcity of comparative studies analyzing infectious disease profiles in hospitalized patients with diabetes mellitus versus those without the condition.

Objective: To compare the infectious disease pattern and infection-related complications between people with or without DM admitted to a non-surgical ward.

Methods: This cross-sectional study included hospitalized patients from a general medicine ward of a medical college hospital over two years by convenient sampling. Participants with dengue fever, COVID-19, undiagnosed, or incomplete demographic information were excluded. A semi-structured case record form was used to document the study participants' demographic, clinical, biochemical data, and culture-sensitivity reports.

Results: A total of 276 patients (DM 123 and non-DM 153) were included in the study. Only 14.6% of DM patients had good glycemic control. Urinary tract (UTI) and respiratory tract infection (RTI) were most prevalent in the DM and non-DM groups. However, the frequency of UTI was higher in the DM group (57.7% vs. 32.3%, adjusted residuals: ±4.2), but the RTI frequency was similar (26.8% vs. 22.2%) between the groups. DM patients with UTI showed a higher number of growths of microorganisms on culture media (63.6% vs. 23.8%, p=0.003), with diverse microorganism patterns (*Escherichia coli*: 64% and *Klebsiella*: 21%) compared to non-DM (E. coli 80%). Gastrointestinal infection (19.6% vs. 4.9%, p<0.05) and blood infection (enteric fever, sepsis, meningitis) (22.2% vs. 8.1%, p<0.05) were more common in the non-DM group compared to DM.

Conclusion: Individuals with DM exhibited a distinct infection pattern from those without DM during hospitalization. *[J Assoc Clin Endocrinol Diabetol Bangladesh,* July 2025;4(2)*: 50-56]*

Keywords: Diabetes mellitus, Infection, Urinary tract infection, Pneumonia, Bangladesh

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Introduction

Diabetes mellitus (DM) is a pandemic metabolic condition with an increasing prevalence. Its burdens are increasing in the form of morbidity, cost, poor quality of life, and mortality related to many direct and indirect complications.[1] Patients with DM are immunocompromised, making them more susceptible to infections. Chronic hyperglycemia is associated with impaired cytokine production, defective phagocytosis, depressed antioxidant system, failure to kill microbes, etc. These defects in the immune system make DM an immune-compromised condition.[2] Hence, infectious diseases may be the first manifestations in people with DM, frequently precipitating an acute hyperglycemic crisis, and increasing mortality. The prevalence of infection may be up to 75% among hospitalized patients with DM. The most common patterns of infections were urinary tract infections (UTI), followed by respiratory

tract infections (RTI).[3,4] Overall, the rate of hospitalization for infection is increasing, especially in people with type 2 DM than in the general population.[5] A Nationwide survey among the US population reported an increased hospitalization rate in adults with DM versus those without DM, depending on infection type, with quite different infection patterns.[6] Infection is the most common cause of hospital admission in the general medicine ward.[7] Most published studies reported only the infection patterns among people with DM. Data regarding infection patterns comparing hospitalized patients with and without DM, and their antibiotic sensitivity patterns, are scarce in the literature, especially from Bangladesh. Knowledge of these issues is important in developing countries like Bangladesh, where the selection of antibiotics based on sensitivity patterns is not available everywhere. Our study aimed to compare infection patterns, organism spectrum, antibiotic sensitivity, and infection-related complications between patients with or without DM during admission in a private medical college hospital in Bangladesh.

Methods

This cross-sectional study included 276 people (DM 123, non-DM 153) admitted with an infection to the general medicine ward of the Medical College for Women and Hospital, Dhaka, Bangladesh, between June 2022 and May 2024. Study sampling was done conveniently. Demographic information, including age, sex, comorbidities [e.g., ischemic heart disease (IHD), chronic kidney disease (CKD), chronic liver disease (CLD), obstructive lung disease (OLD), etc.], along with routine investigation findings, were recorded in a semi-structured case record form by a trained physician. Infection patterns were categorized and compared based on the presence or absence of DM. DM was diagnosed based on the previous medical records and/or persistent high blood glucose of ≥11.1 mmol/L after admission. Stress hyperglycemia was excluded by checking HbA1c%≥6.5 in people with normal hemoglobin. Patients who were on steroids and had high blood glucose were not considered DM unless previously diagnosed or HbA1c ≥6.5% on admission. All other patients who did not meet the DM diagnostic criteria were included in the non-DM group. The status of control of DM was based on fasting (FPG) and post-meal blood glucose (PPG), along with HbA1c measured during the period of hospitalization. Fasting plasma glucose of 4.4-7.2 mmol/L and after-meal plasma glucose below 10.0 mmol/L, along with HbA1c below 7%, was considered controlled DM. Any patient with DM who does not fulfil all of the three criteria was considered to have uncontrolled DM.

All patients, aged ≥12 years, who were hospitalized primarily due to infectious causes in the general medicine ward were selected for the study. Those with dengue fever or any other epidemic outbreak e.g. COVID-19 infection, patient with a diagnostic dilemma, a patient who was referred to another hospital without a confirmed diagnosis, incomplete clinical, demographic, and biochemical information, patient who got hospitalization due to non-infectious causes but developed a hospital-acquired infection, and those patients not willing to give consent to participate in the research were excluded from the study. Infection was diagnosed based on the clinical features and laboratory findings, with or without positive culture. Infection patterns were categorized according to different body systems. UTIs included both upper (pyelonephritis) and lower UTI (cystitis, urethritis) with or without complications [urosepsis, acute kidney injury (AKI)]. RTI included both upper and lower RTI (pneumonic consolidation), including pulmonary tuberculosis. Gastrointestinal tract (GIT) infection included most commonly acute gastroenteritis, gastrointestinal and peritoneal tuberculosis, and infection of the hepatobiliary-pancreatic system, including viral hepatitis. Blood infections included enteric fever, sepsis, including meningoencephalitis. If the patient developed sepsis with primary foci of infection (e.g. urinary tract, respiratory tract), then it was classified to that particular system. However, if the primary foci are unknown, it was categorized as a blood infection. Skin and soft tissue infections included cellulitis, boil, herpes zoster, or any other infection that requires hospitalization. Infections that do not fall within above-mentioned category were classified as others infection.

Statistical analysis was conducted using the SPSS software (version 23, SPSS, Inc., Chicago, IL). Median with interquartile range (IQR) was used to present the numerical variables, and frequency with percentage for qualitative variables. Comparison between two groups for numerical variables was analyzed by the Mann-Whitney U test, and for qualitative variables by Pearson's chi-squared test (post hoc from adjusted residuals, AR) or Fisher's exact test as applicable. A two-tailed p-value of less than 0.05 was considered statistically significant.

This study was approved by the Ethical Committee of Medical College for Women, Uttara 1230, Dhaka, on

26/05/2022. All the procedures followed the ethical committee standards and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Result

The characteristics of the study participants are shown in Table-I. People with DM were older than those without DM. The frequency of the female sex was also higher in the DM group. Although the number of comorbidities was similar, the frequency of hypertension, CKD, and IHD, as well as the active diseases of any other system, was higher in the DM group than in the non-DM group. Only the systolic blood pressure was higher in the DM group. Although the frequency of anemia was higher in the DM group, the hemoglobin level was lower only in female patients with DM than in non-DM patients. FPG, PPG, and HbA1c reports were available in 104, 90, and 74 patients with DM. The mean±SD of them were 9.9±4.9 mmol/L, 11.9±5.0 mmol/L, and 8.1±2.3% respectively. Based on available data, only 18 (14.6%) patients had good glycemic control.

The infection pattern showed that people with DM were admitted more with UTI (AR: ±4.2) but less with GIT (AR: ±3.6) and blood infections (AR: ±3.2) than those without DM. The study groups' RTI and other infections occurred at similar frequencies (Figure-1). Among people with DM, the frequency of uncomplicated UTI

Table-I: Characteristics of the study participants (n= 276)

Variables	DM (n=123)	Non-DM (n=153)	p-value
Age, years	56.0 (48.0-65.0)	35.0 (23.5-55.0)	**<0.001†**
<40years	12 (9.8)	86(56.2)	**<0.001**
≥40years	111(90.2)	67(43.8)	
Gender	Gender	Gender	
Male	27(22.0)	70(45.8)	**<0.001**
Female	96(78.0)	83(54.2)	
Number of co-morbidities			
1	51(57.3)	24(64.9)	0.431
≥2	38(42.7)	13(35.1)	
Comorbidities			
Hypertension	77(62.6)	28(18.3)	**<0.001**
Chronic kidney disease	34(27.6)	6(3.9)	**<0.001**
Asthma/COPD	13(10.6)	15(9.8)	0.834
Cerebrovascular disease	7(5.7)	2(1.3)	0.083*
Ischemic heart disease	13(10.6)	5(3.3)	**0.015**
Number of active diseases on admission			
1	56 (45.5)	111 (72.5)	**<0.001**
≥2	67 (54.5)	42 (27.5)	
Systolic blood pressure, mm-Hg	120.0 (110.0-130.0)	110.0 (100.0-120.0)	**<0.001†**
Diastolic blood pressure, mm-Hg	70.0 (70.0-80.0)	70.0 (62.5-80.0)	0.085†
Hemoglobin, gm/dL			
Male	11.1 (9.4-13.1)	12.5 (10.5-13.9)	0.064†
Female	9.9 (8.7-11.3)	10.9 (10.0-12.1)	**0.001†**
Anemia (M <13, F <12)	96 (78.0)	97 (63.4)	**0.008**
Glycemic Status			
Controlled	18 (14.6)	NA	
Uncontrolled	105 (85.4)	NA	

Data were expressed in frequency (%) or median (IQR) as appropriate
Within parentheses are percentages over the column total for qualitative variables
Pearson's chi-squared, or *Fisher's exact, or †Mann-Whitney U test was done as appropriate

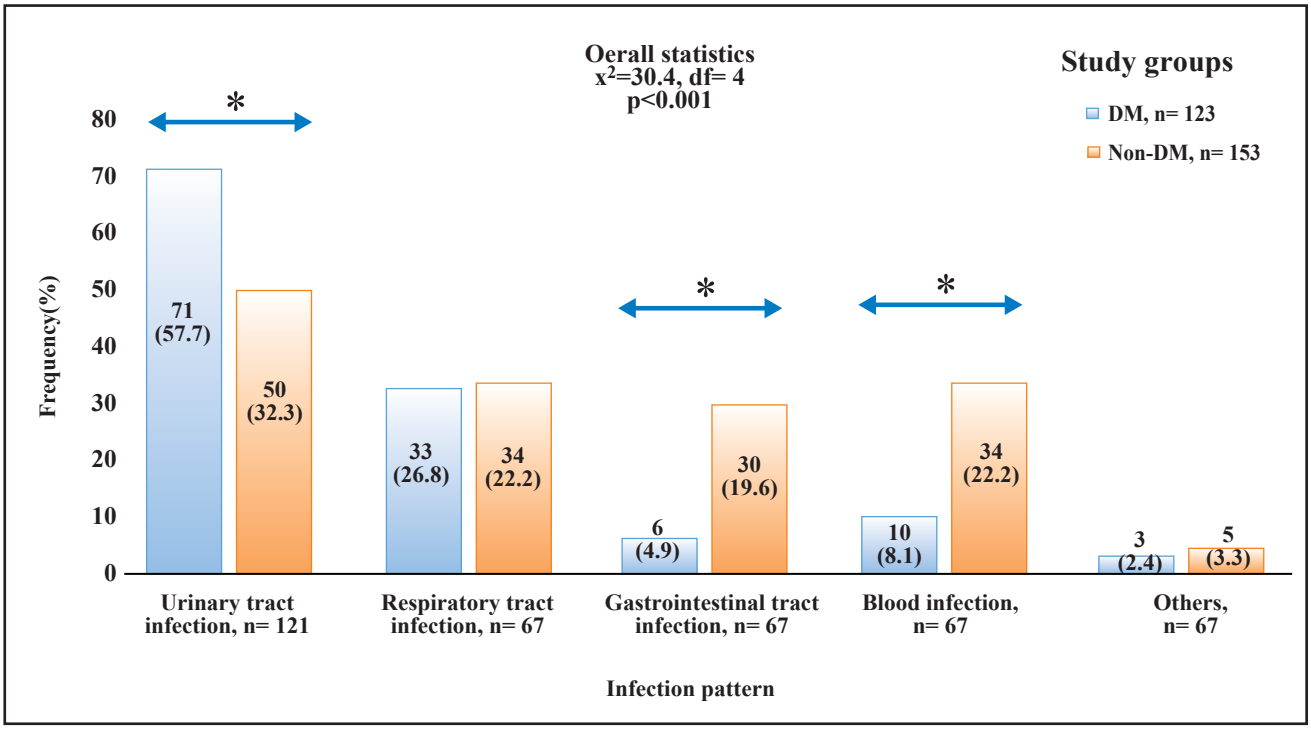

Figure-1: Infection patterns of the study population (n= 276)

Within parentheses are percentages over the study groups
Pearson's chi-squared test with post hoc analysis was done, *significant pair

and pneumonia was higher, but acute gastroenteritis, acute viral hepatitis, RTI other than pneumonia, and blood infection, including enteric fever, occurred more frequently in the non-DM group (Table-II).

Table-II: Detailed infection patterns among the study participants (n= 276)

Infection patterns	DM (n= 123)	Non-DM (n=153)
Urinary tract		
Uncomplicated infection	60 (48.8)	41 (26.8)
Urosepsis	8 (6.5)	8(5.2)
Acute pyelonephritis	3 (2.4)	1 (0.7)
Gastrointestinal tract		
Acute gastroenteritis	5 (4.1)	20 (13.1)
Hepatic abscess	1 (0.8)	0
Acute viral hepatitis	0	8 (5.2)
Chronic HBV infection	0	1 (0.7)
Intestinal tuberculosis	0	1 (0.7)
Respiratory tract		
Pneumonia	21 (17.1)	10 (6.5)
Upper respiratory tract infection	10 (8.1)	18 (11.8)
Pulmonary tuberculosis	2 (1.6)	6 (3.9)
Blood		
Enteric fever	9 (7.3)	29 (19.0)
Sepsis	1 (0.8)	2 (1.3)
Meningoencephalitis	0	3 (2.0)
Others, including skin & soft tissue	3 (2.4)	5 (3.3)

Among participants with UTI, the people with DM were older, with a higher frequency of females than the non-DM group. Urine culture showed higher growth of microorganisms in the DM group than in the non-DM group. Among the participants with DM, the main pathogens were *Escherichia coli* (64%) and *Klebsiella* (21%). On the other hand, the non-DM group was almost exclusively affected by E. coli (80.0%) (Table-III). The antibiogram showed that people with DM were sensitive to *E. coli* predominantly by meropenem (83.3%), piperacillin-tazobactam (75.0%), gentamicin (66.7%), and nitrofurantoin (66.7%). Among 27 patients developing AKI, 11 (8.9%) had DM and 16 (10.5%) did not (p=0.674). The predominant cause of AKI was UTI with urosepsis in both groups (Table-IV). Blood culture was shown to grow organisms in 29.4% (5/17) and 16.1% (5/31) among people with and without DM, respectively. Among people with DM, the microorganisms were *Klebsiella* (n=2), *E. coli* (n=1), *Enterococcus* (n=1), and *Salmonella typhi* (n=1). Among people without DM, the microorganisms were *E. coli* (n=1), *Enterococcus* (n=1), coagulase-negative *Staphylococcus* (n=1), Mycobacterium tuberculosis (n=1), *S. typhi,* and *S. paratyphi* (n=1).

Table-III: Characteristics of the study participants with urinary tract infection (n=121)

Characteristics	DM (n=71)	Non-DM (n=50)	p-value
Age, years	59.0 (48.0-65.0)	44.0 (22.8-62.3)	**0.002***
Age group: ≥40 years	63 (88.7)	28 (56.0)	**<0.001**
Gender: Female	59 (83.1)	31 (62.0)	**0.009**
Comorbidities			
Hypertension	45 (63.4)	13 (26.0)	**<0.001**
Chronic kidney disease	21 (29.6)	5 (10.0)	**0.010**
Ischemic heart disease	8 (11.3)	2 (4.0)	0.193†
Culture done	44 (62.0)	21 (42.0)	**0.030**
Growth in culture media	28/44 (63.6)	5/21 (23.8)	**0.003**
Organisms			
E. coli	18/28 (64.3)	4/5 (80.0)	
Enterococcus	1/28 (3.6)	0	
Klebsiella	6/28 (21.4)	0	
Pseudomonas	1/28 (3.6)	0	
Mixed growth	2/28 (7.1)	1/5 (20.0)	

Data were expressed in frequency (%) or median (IQR) as appropriate
Within parentheses are percentages over the column total for qualitative variables
Pearson's chi-squared, or †Fisher's exact, or *Mann-Whitney U test was done as appropriate

Table-IV: Infection patterns and demographic profile of patients who developed acute kidney injury (n=27)

Characteristics	Total	DM (n=11)	Non-DM (n=16)	p-value
Age, years	52.0 (40.0- 62.0)	56.0 (50.0- 65.0)	45.0 (23.0-60.8)	0.080*
Age group: ≥40 years	22 (81.5)	11 (100.0)	11 (68.8)	0.060
Gender: Female	16 (59.3)	8 (72.7)	7 (50.0)	0.427
Causes of AKI				
Urinary tract infection with urosepsis	21 (77.8)	7 (63.7)	14 (87.5)	
Acute gastroenteritis with dehydration	3 (11.1)	1 (9.1)	2 (12.5)	
Pneumonia with septicemia	3(11.1)	3 (27.3)	0	
Comorbidities				
Hypertension	12(44.4)	6 (54.5)	6 (37.5)	0.452
Chronic kidney disease	6 (22.2)	3 (27.3)	3 (18.8)	0.662

Acute kidney injury (AKI); Mann-Whitney U test or Fisher's exact test was done
Within parentheses are percentages over the column total for qualitative variables

Discussion

In this cross-sectional study, UTI and RTI were the most common infections (57.7% and 26.8%, respectively), contributing to around 84% of all infectious causes of hospitalization in the DM group. Whereas, UTI, GIT infection, and blood infection were the major infection patterns among the non-DM group, contributing to around 77% of all infectious causes of hospitalization. Masoodi SR, et al. reported skin and soft tissue infection was the most common (42.8%) infection among hospitalized DM patients, followed by RTI (30.2%), and UTI (28.4%).[8-10] Ahmadi F, et al. also reported similar findings where diabetic foot infections were the most prevalent (32.5%) among hospitalized DM patients in the general medicine ward followed by RTI, soft tissue abscess, and UTI.[11] Overall skin and soft tissue infections were observed as the most common type of infection in many other studies.[9-12] In our study, we included hospitalized patients from a single medicine ward. In the hospital where the study was conducted, patients with skin and soft tissue infections were mainly admitted to the surgery department, which could reduce

the overall prevalence of skin and soft tissue infections. Our DM patients were mainly elderly females with uncontrolled DM, which makes them more vulnerable to UTI. GIT infection included mostly acute gastroenteritis along with viral hepatitis, which we found significantly higher percentages in the non-DM population, which might be attributed to their age, sex distribution, and eating behaviors outside the home in our population. Furthermore, we included enteric fever, sepsis (without primary foci), and meningoencephalitis in the blood infection group. Sepsis with a primary focus is categorized as the infection of the respective system. The majority of the patients developed sepsis from complicated UTI and RTI, which were documented as UTI and RTI. This may contribute to a lower percentage of blood infection in the DM group than in the non-DM group.

In Bangladesh, infection patterns in DM patients were studied among hospitalized patients, though it was not compared to non-DM people. They found UTI was the most common infection pattern (53.8 %), followed by RTI (28%), which is very similar to our study findings. GIT and skin/soft tissue infections were observed with a frequency comparable to our study.[13] Infection patterns among DM patients may vary from country to country based on study methodology, sampling technique, and study population. The observed infection patterns differ from many international studies due to different sampling techniques and study designs. However, we found similar results when the study was done in our community. In addition to infection patterns in DM patients, our study adds information by comparing it with non-DM patients.[13,14]

Growth in culture media was observed more among the participants with DM. About 36.4% of DM patients with UTI had no growth on culture media in our study. Muzammil M, et al. also reported no growth of organisms on culture media in 44.2% of patients with complicated UTI.[15] Interestingly, He K, et al. observed that DM patients with symptomatic UTI had only 44.1% positive growth on culture media, whereas asymptomatic UTI patients had 70.5% growth on culture media.[16] Kumar R, et al. reported that the culture positivity rate is almost double in DM patients with UTI compared to non-DM patients.[17] E. coli was the most prevalent organism isolated from urine culture in both groups. Isolated organisms from UTI patients with DM were more diverse, as observed in many studies.[17-19] AKI was developed in around 10% of patients. In one study of 1132 UTI patients, AKI developed in nearly 14% of patients.[20] Differences in the prevalence of AKI may be due to the study population, as we included patients with all types of infection, including GIT and RTI. Elderly females with DM were more likely to develop AKI and upper UTI in our study. Hsiao CY, et al. reported that the presence of DM, upper UTI, baseline low GFR, and asymptomatic on admission were independent predictors of AKI among UTI patients.[21] We found that elderly females with DM were more likely to develop AKI and upper UTI. This study was done in a private medical college hospital in Dhaka, Bangladesh. So, the infection patterns of patients from government medical colleges may differ. Most of the study population was female so that the gender distribution may alter the findings. Some patients had taken preadmission antibiotics for fever by the local physicians, contributing to no growth in culture media. Avoiding these patients could produce more accurate results and classify organisms. Despite having several limitations, this study provided some new information regarding how the presence of DM affects the infection patterns, the spectrum of micro-organisms, and their sensitivity patterns in the Bangladeshi population. The findings from this study might guide our clinicians to give more emphasis on common infections and take appropriate steps to prevent possible complications.

Conclusions

The most frequent infections seen in patients admitted to a general medicine ward of a tertiary care private hospital were UTI and RTI. Those with DM experienced more UTIs than non-DM individuals, but they also experienced fewer GIT and blood infections. UTI in DM patients had more growth in culture media with diverse organism patterns compared to non-DM. Our study findings will help clinicians and policymakers to manage infection during hospitalization more efficiently.

Conflict of interest

The authors have no conflicts of interest to disclose.

Acknowledgements

We are grateful to the study participants and their attendants who actively cooperated during sample collection.

Disclosure

This study is not funded by any companies, NGOs, or institutions.

Financial Disclosure

The author(s) received no specific funding for this work.

Data Availability

Any queries regarding this study should be directed to the corresponding author, and supporting data are available from the corresponding author upon reasonable request.

Ethical Approval and Consent to Participate

This study was approved by the Ethical Committee of Medical

College for Women, Uttara 1230, Dhaka on 26/05/2022.

How to cite this article: Hasan MH, Haque PT, Munira M, Bithi TI, Karim R, Morshed MS. Infectious disease patterns of patients with diabetes mellitus compared to non-diabetes in a non-surgical ward of a medical college hospital. J Assoc Clin Endocrinol Diabetol Bangladesh 2025; 4(2): 50-56

Publication History

Received on: 16 Jan 2025

Accepted on: 28 Feb 2025

Published on: 01 Jul 2025

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