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## Original Article

## Determining frequency and pattern of infections associated with diabetes based educational hospitals in Ahvaz city; Iran

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## ABSTRACT

**Background:** Diabetes mellitus is a metabolic disease known as one of the most common illness in the world. It is believed that diabetic patients are at high risk of varied infections than non-diabetics. The aim of this study was to determine the frequency and pattern of infections in diabetic patients admitted to the internal wards of educational hospitals of Ahvaz Jundishapur University of Medical Sciences.

**Methods:** This descriptive cross-sectional study was performed on 700 diabetic patients from January 2014 to December 2015 in internal wards (general, endocrine, gastroenterology, lung, nephrology, cardiology, neurology and infectious diseases) of educational hospitals affiliated to Ahvaz Jundishapur University of Medical Sciences. Data included demographic information, type of diabetes treatment, duration of diabetes mellitus, final diagnosis, and blood sugar on admission that were analyzed statistically.

**Results:** Out of 700 patients, 374 (53.4%) women and 326 (46.6%) men were entered into this study. The number of non-infectious and infectious patients were 506 (72.3%) and 194 (27.7%). The mean of age, duration of diabetes, and glucose were  $62.34 \pm 14.38$  years,  $11.11 \pm 7.18$  years, and  $271.98 \pm 90$  (mg/dl) in patients with infectious diseases respectively. The most common infectious illnesses were diabetic foot infections (32.5%), pneumonia (18%), soft tissue abscess (13.9%), and urinary tract infections (11.3%).

**Conclusion:** Infectious diseases are one of the most common factors to hospitalize diabetic patients (27.7%), most of whom had diabetic foot infections, pneumonia, and soft tissue abscess.

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## 1. Introduction

Diabetes mellitus has been known as one of the most common diseases of metabolic disorder that is characterized by hyperglycemia due to defects in insulin secretion or insulin action, or both. Symptoms of hyperglycemia include weight loss, polydipsia, and polyuria. Additionally, uncontrolled blood glucose complications such as ketoacidosis or the nonketotic hyperosmolar syndrome may also be life-threatening in these individuals [1]. It is associated with long-term damage to the heart, kidneys, eyes, nerves, and blood vessels. The global prevalence of diabetes in the adults is 9.6% (men:10.5%; women:8.8%) [2–4]. About 7.7% of Iranian adults aged 25–65 have diabetes that is more prevalent in urban areas (6.6%)

than in non-urban areas (5.7%) and also 16.8% of them have an impaired glucose tolerance [5]. The prevalence of this disease in Ahvaz was approximately 15.3% in people aged 10–19 years [6]. Therefore, diabetes can be considered as one of the serious diseases that threatens national health.

Diabetics are exposed to various types of infections, including pneumonia, urinary tract infections, and skin infections. Pneumonia results from hyperglycemia, high risk of aspiration, low immunity, pulmonary microangiopathy, pulmonary dysfunction, and hemodialysis diseases. In addition, diabetic nephropathy may increase by approximately 40% that is a major cause of kidney disease and debilitate them for fighting pneumonia because of old age and associated disorders [7]. Skin and soft tissue infections are the major cause of death from diabetes. Different complications of diabetes (such as sensory neuropathy, vascular impairment, immunopathy, and metabolic disorders) can infect these patients [8]. Glycosuria, immune deficiency, duration of diabetes, and

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bladder dysfunction are the causative agents of urinary tract infection [9]. Diabetic foot is still the leading cause of more than half of nontraumatic amputation and hospitalization. In fact, every 30 s in the world, the lower extremity of the patient is cut off due to diabetes, and it can undoubtedly be said that the amputation increases the mortality rate. About 15–25% of diabetic patients may experience diabetic foot infection during their lifetime. The annual risk of diabetic foot ulcers in people with diabetes is estimated at 2%. The prevalence of diabetic foot ulcers ranges from 1.3% to 12% [10].

Considering that diabetes is one of the most common problems in the country as well as in the city of Ahvaz and one of the major causes of hospitalization, therefore, it is necessary to diagnose and treat diabetic infections to reduce mortality and related illnesses. Thus, this study shows the frequency and pattern of infectious diseases leading to hospitalize adult patients in the internal divisions of educational hospitals.

## 2. Methods

This study was diagnosed as a descriptive epidemiologic and one-year retrospective study based on the information of Ahvaz educational hospitals. The sample size was 700 that was selected according to the number of beds in Imam Khomeini, Razi, and Golestan hospitals. 300 patients from Imam Khomeini Hospital, 150 from Razi Hospital, and 250 from Golestan Hospital entered into the study. The sampling method was to examine the hospital records that were eligible to be included in the study. In order to neutralize the possible effect of climate change on the prevalence of hospitalization, from each season, equal numbers of patients were selected randomly between 2014 and 2015. The variables included age, sex, duration of diabetes, blood glucose levels, type of diabetes treatment (insulin or oral therapy, no treatment), season, and final diagnosis.

Inclusion criteria consisted of people aged  $\geq 14$  years, diagnosis of diabetes before or during admission, hospitalization in internal medicine wards (general, gastroenterology, lung, endocrine, nephrology, neurology, cardiology, and infectious diseases). Exclusion criteria for leaving the study were patients  $< 14$  years of age and incomplete hospital records.

After collecting necessary information, data were analyzed using SPSS software (version 22). Qualitative variables (frequency, Chi-square) and quantitative variables (mean, standard deviation, and ANOVA) were calculated. The significance level was 0.05.

This study examined patients' medical records of the hospital without any interventions while respecting data privacy and trustworthiness during the study.

## 3. Results

In this study, out of 700 patients, 374 (53.4%) were women and 326 (46.6%) were men. The average age of patients was  $59.87 \pm 13.56$  years aged 16–96. The mean duration of patients with diabetes mellitus was  $9.83 \pm 6.35$  years, in the ranges of 0–33 years. Zero means the diagnosis of diabetes during admission. The mean blood glucose level was  $256.50 \pm 89.23$  (mg/dl) in the range of 56–660. In this study, were 115 patients (16.4%) in the cardiology, 103 (14.7%) in nephrology, 99 (14.1%) in general, 90 (9.9%) in infectious diseases, 80 (11.4%) in the neurology, 75 (10.7%) in gastroenterology, 74 (10.6%) in lung, and 64 (9.1%) in endocrine wards. The frequency of patients in spring, summer, and winter season was 176 (25.1%) and in the autumn 172 (24.6). 356 (50.9%) patients were controlled their blood glucose level by oral medications, 327 (46.7%) received insulin therapy. Also, 17 patients did not use drugs to control their blood glucose. In this study, 506 patients

(72.3%) were admitted for non-infectious reasons and 194 (27.7%) were diagnosed with infectious diseases in the hospital.

The most common causes of hospitalization in diabetic patients were cerebrovascular diseases (10.1%), diabetic foot infection (9%), gastrointestinal bleeding and gastric ulcer (8.7%), acute coronary syndrome (7.6%), and uncontrolled blood glucose (7.1%) (Table 1).

The most prevalent infectious diseases were diabetic foot infections (32.5%), pneumonia (18%), and soft tissue abscess (13.9%). Cerebrovascular disease, gastrointestinal bleeding, gastric ulcer, and acute coronary syndromes were 14, 12.1 and 10.5% respectively were the most common non-infectious reasons (Table 2).

According to this study, 50.5% of patients with infectious diseases were men and 49.5% were women. There was not a significant difference between them ( $P = 0.696$ ) (Table 3). The results showed that diabetic foot infection, pneumonia, and soft tissue abscess were the most common causes of infections in men (33.3%, 19.4%, and 15.3% respectively) and in women (31.3%, 16.7%, and 12.5% respectively) that were similar in both sexes.

The average age of patients with infectious diseases was  $62.34 \pm 14.38$  years and the mean age of other patients was  $58.95 \pm 13.28$  years, which was statistically significant between them and showed that diabetic patients with infectious diseases had a higher average age than other patients ( $P = 0.005$ ) (Table 3).

The mean duration of diabetes mellitus in patients with infectious diseases was  $11.10 \pm 7.8$  years and in the other patients was  $9.34 \pm 5.94$  years. The statistical analysis reported that the incidence of diabetes in infected patients was higher than non-infected patients and there was statistically significant difference between them ( $P = 0.003$ ) (Table 3).

The mean of blood sugar on admission in diabetic patients with infectious diseases and other patients were  $271.98 \pm 90.25$  (mg/dl) and  $250.57 \pm 88.21$  (mg/dl) that displayed a significant difference. The people with infectious diseases had higher blood glucose than other patients ( $P = 0.004$ ) (Table 3).

The people with infectious and non-infectious diseases used insulin (55.7%, 43%) and oral medications (40.7%, 54.7%) respectively to control their blood glucose, while patients with infectious diseases used insulin and oral drug more than other patients. There was a statistically significant difference between them ( $P = 0.003$ ) (Table 3).

Diabetic patients with infectious diseases used insulin (108), oral medications (79) and 7 of them did not use the drug to control their blood sugar. The most common infectious diseases in people used insulin or oral medication was diabetic foot infections (36.1% and 30.4% respectively) and in non-drug group was tuberculosis (1/57%) (Table 4).

## 4. Discussion and conclusion

Out of 700 patients with diabetes mellitus admitted to internal medicine wards of educational hospitals affiliated to Ahvaz Jundishapur University of Medical Sciences were 374 (53.4%) women and 326 (46.6%) men. 50.5% of the patients with infectious diseases were men and 49.5% of them were women, and there was no

**Table 1**  
The most common diseases of hospitalization in diabetic patients.

Disease	Frequency	Percent
Cardiovascular diseases	71	10.1
Diabetic foot Infection	63	9
Gastrointestinal bleeding and gastric ulcer	61	8.7
Acute coronary syndromes	53	7.6
Uncontrolled blood sugar	50	7.1
Others	402	57.42

**Table 2**

The most common diseases of hospitalization for infectious and non-infectious diseases.

Infectious diseases	Frequency	Percent	Infectious diseases	Frequency	Percent
Diabetic foot Infection	63	32.5	Cardiovascular diseases	71	14
Pneumonia	35	18	Gastrointestinal bleeding and gastric ulcer	61	12.1
Soft tissue abscess	27	13.9	Acute coronary syndromes	53	10.5
Urinary tract infection	22	11.3	Uncontrolled blood sugar	50	9.9
Tuberculosis	12	6.2	End stages of renal failure	40	7.9
Others	35	18.04	Others	231	45.65

**Table 3**

The characteristics of diabetic population.

Frequency (percent) or standard division $\pm$ mean	Infectious patients	Non-infectious patients	p-value
Sex	Male:98(50.5) Female:96(49.5)	Male:228(45.06) Female:278(54.94%)	P=.196
Age	62.34 $\pm$ 14.38	58.95 $\pm$ 13.12	P=.005
Duration of diabetes	11.11 $\pm$ 7.18	9.34 $\pm$ 5.94	P=.003
Blood glucose level on admission	271.98 $\pm$ 90.25	250.57 $\pm$ 88.21	P=.004
No drug	3.6%	2%	
Using insulin	55.7%	43.3%	P=.003
Using oral medications	40.7%	54.7%	

**Table 4**

Incidence of infections.

	Infectious diseases	Frequency	Percent
No drug	Tuberculosis	4	57.1
	Pneumonia	2	28.6
	Meningitis and encephalitis	1	14.3
insulin	Diabetic foot Infection	39	36.1
	Pneumonia	22	20.4
	Soft tissue abscess	15	13.9
	Urinary tract infection	14	13
Oral medication	Diabetic foot Infection	24	30.4
	Pneumonia	12	15.2
	Soft tissue abscess	11	13.9
	Urinary tract infection	8	10.1

statistically significant difference between them.

Our survey was consistent with the studies of Zargar, Asefzadeh, and Golsha that showed no significant difference between sex and the incidence of infection in diabetic patients [11–13]. Regarding gender distribution, despite their studies, in our investigation, the number of female patients was higher than that of male patients. To determine the role of gender in the incidence and severity of infection in diabetic patients, another study needs to conduct.

The average age of patients in our study was compatible with that of patients in the studies of Asifzadeh and Golsha and the mean age of patients in our research was greater than that of patients in Zargar's study (11). In our study, the mean age of patients with infectious diseases was higher than that of other patients. McDonald's and et al. (2014) that demonstrated the incidence of urinary tract infections, pneumonia, and sepsis increased sharply with age. For example, the prevalence of pneumonia among patients over the age of 85 was 6–8 times higher than that of patients aged 65–69 [14] because of reducing caring and the immune system with increasing age.

In our study, the average duration of diabetes in infected patients was higher than other patients that was not consistent with the study of Asefzadeh, Golsha, and Zargar (11). Some patients get tired of the duration of the treatment and may take drug irregularly that leads to not control the sugar and increase the risk of infections.

The current study showed that the mean of blood sugar on the admission of patients with infectious diseases was higher than

that of other patients. Golsha's study also indicated that blood glucose level on admission was inappropriate especially more in diabetic patients with infectious (13).

In our investigation, diabetic foot infections with insulin-dependent and non-insulin-dependent diabetes mellitus were more consistent with the study of Al-Ayd, which seems to be associated with distal neuropathy and foot disability, as well as previous history of foot infection or amputation [15].

One of the common infections in diabetic patients was pneumonia diagnosed through clinical and radiographic findings. Diabetes reduces muscle strength, capillary blood volume, and diffusing capacity of the lungs [16]. In the present study, the prevalence of pneumonia in insulin-dependent diabetic patients was higher than in non-insulin dependent diabetics.

Urinary tract infections result from intestinal pathogens. Different impairments in the immune system, poor metabolic control, and bladder emptying due to autonomic neuropathy may contribute to increasing the risk of urinary tract infections [17]. Addict people with diabetic are more sustainable to urinary tract infection as compare addict people without diabetics [18]. In our study, this disease was ranked fourth in insulin-dependent and non-insulin-dependent groups.

Although recent advancements in diagnosis and treatment decrease the risk of infection-related mortality in diabetic patients, they are more exposed to infection and hospitalization than other people. Therefore, it is necessary to train and take care to prevent and reduce infections. Considering that diabetic foot infections, soft tissue abscess, and pneumonia had a higher incidence of infections in diabetic patients, identification of underlying vascular and nervous diseases, tight control of blood glucose, treatment of infection in the early stages are the strategies to reduce the severity of the infection. Therefore, the results of this study can increase the awareness of common infectious causes leading to hospitalization in diabetic patients.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.dsx.2019.06.012>.

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