International Journal of Medical and Health Sciences
Volume 11 Issue 03 September 2025
ISSN- 2456 - 6063
DOI: https://doi.org/10.69980/gfs9k223

CLINICAL AND HEALTHCARE UTILIZATION FACTORS ASSOCIATED WITH HOSPITAL READMISSION AMONG DIABETIC PATIENTS

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Received:- 25/07/25	Revised:-26/08/25	Accepted:-27/09/25	Published:- 28/09/25

Abstract

Hospital readmission among diabetic patients remains a significant challenge for healthcare systems due to its association with increased clinical burden, healthcare costs, and reduced quality of care. This study aimed to examine the clinical and healthcare utilization factors associated with hospital readmission among diabetic patients. A quantitative analytical design was employed using a structured dataset comprising 25,000 patient records with variables related to demographic characteristics, clinical indicators, healthcare utilization, and readmission status. Descriptive and inferential statistical analyses were conducted to identify patterns and associations between study variables and hospital readmission. The results indicated that 47.02% of patients experienced readmission, highlighting a substantial readmission burden. Clinical factors such as age, primary diagnosis, medication use, and medication change were associated with variations in readmission rates. Patients with diabetes as the primary diagnosis and those undergoing medication adjustments showed relatively higher readmission levels. Healthcare utilization factors demonstrated the strongest association, with readmission rates increasing significantly among patients with higher numbers of prior inpatient, emergency, and outpatient visits. Additionally, longer hospital stays and higher healthcare utilization were observed among readmitted patients. The findings suggest that hospital readmission among diabetic patients is influenced by both clinical complexity and prior healthcare utilization. Identifying high-risk patients based on these factors can support targeted interventions, improve discharge planning, and enhance continuity of care. These insights contribute to evidence-based strategies aimed at reducing readmission rates and improving overall patient outcomes in diabetes management.

Keywords: Diabetes mellitus, Hospital readmission, Clinical factors, Healthcare utilization, Patient outcomes, Chronic disease management

1. Introduction

One of the most common chronic illnesses globally, diabetes mellitus is a major burden to healthcare systems because of its chronic complications, frequent hospitalizations, and readmission. Hospital readmission of diabetic patients has become a vital measure of the quality of health care, the ability of the clinical management and continuity of patient care. The frequent readmission of patients in hospitals does not only escalate healthcare expenses, but it also indicates inadequacies in disease management, discharge strategies, and post-hospital care. Recent data indicates that diabetic patients frequently rehospitalize, and their rehospitalizations are often related to the presence of complications like poor glycemic control, comorbidities, and insufficient outpatient care (Soh et al., 2023).

Hospital readmission among diabetes is multidimensional with both clinical and system-based determinants. Diabetic patients usually need highly complex treatment, which includes medication management, lifestyle changes, and constant monitoring, and are at risk of re-utilizing acute care. The analysis of the recent studies revealed that the factors of acute care reuse (such as emergency visits and rehospitalizations) are conditioned by the severity of the disease, comorbidities, and barriers to healthcare access (Rubin and Shah, 2021). Moreover, acute cases of hypoglycemia and hyperglycemia are significant causes of repeated hospitalization, which means that glycemic stability can help to decrease readmission (McCoy et al., 2018).

Besides the clinical factors, differences in readmission rates have been found among the various population groups. Hospital readmission has been related to socio-demographic factors, such as race and ethnicity, indicating the impact of access to healthcare, social determinants, and disparities in care delivery (Rodriguez-Gutierrez et al., 2019). On the same note, diabetics under various insurance plans have demonstrated a different rate of readmission with the higher rate usually associated with patients who have had severe metabolic events like hypoglycemia and hyperglycemia (McCoy et al., 2017). Such results demonstrate the necessity of broad and fair strategies to diabetes care.

Patterns of healthcare use are important in the determination of readmission risk. Repeated hospitalizations, emergency room visits, and outpatient visits can often be indicators of disease unsteadiness and poor management. Past studies in populations of chronic diseases have shown that frequent healthcare visits are powerful predictors of readmission in the future, stressing the role of early and coordinated care (Donzé et al., 2017). Predictive modeling approaches have also been considered in recent years to classify high-risk patients based on clinical and utilization data, which also highlights the importance of these variables in predicting readmissions (Lu and Uddin, 2022).

The other factors contributing to hospital readmission are patient experience and quality of care. Research has indicated that the likelihood of readmission is related to patient-reported outcomes such as satisfaction with hospital care and perceived quality of discharge planning. Ineffective communication, the unawareness of the discharge plan, and the insufficiency of follow-up treatment can enhance the rehospitalization risk in patients with chronic diseases, such as diabetes (Watson et al., 2022). The results support the significance of patient-centered care and communication in preventing unnecessary readmissions.

An increasing literature has established various clinical and healthcare-associated determinants of readmission among diabetic patients. Systematic reviews have pointed out that age, comorbidities, length of stay, medication usage, and previous healthcare usage are some of the most important predictors of readmission (Robbins et al., 2019). Another effective method that has been proposed to enhance patient outcomes and reduce readmission rates is the improvement of inpatient diabetes management and the specialized care, including the participation of endocrine hospitalists (Zilbermint, 2021). In addition, recent papers have highlighted the fact that readmission risk varies in relation to primary or secondary diagnosis of diabetes, which further points to the complexity of the condition and its treatment (Rubin et al., 2023).

Although evidence about diabetes-related readmissions keeps on increasing, more needs to be analyzed in terms of understanding the relationship between clinical features and patterns of healthcare utilization and readmission in diabetic patients. Taking these factors into consideration will assist in determining patient groups that might need more attention, advancement of discharge planning, and continuity of care. Hence, this research will be used to assess the clinical and healthcare utilization variables linked with readmission into the hospital by diabetic patients. The targeted goals are:

- To describe the clinical and healthcare utilization profile of diabetic patients.
- To assess hospital readmission patterns among diabetic patients.
- To examine the association between clinical factors and hospital readmission.
- To evaluate the relationship between healthcare utilization factors and hospital readmission.

2. Methodology

2.1 Research Design

The given research employed a quantitative analytical design to investigate the factors that relate to clinical and healthcare utilization and predict hospital readmission in diabetic patients. The aim of the study was to find statistically significant relationships between patient-related features, clinical predictors, hospital usage, and readmission rates. Since this was a research to determine relationships between existing variables and not a prediction model, descriptive and inferential statistics seemed suitable.

2.2 Data Source and Study Population

The research was based on secondary data on the structured hospital data of diabetic patients (DD, 2023). The data consisted of patient-level data regarding demographic factors, type of diagnosis, factors associated with treatment, healthcare use and hospital readmission. The population of the study was a sample of patients with diabetes who were hospitalized and the data was captured in the dataset, whereby the record represents a single encounter between a patient and a nurse. This dataset had 25,000 records and 17 variables, which are pertinent to the study objective.

2.3 Study Variables

The dependent variable was hospital readmission status which was divided into readmission and not readmission. The independent variables were divided into clinical factors and healthcare utilization factors. The factors that were considered clinical were age group, primary diagnosis, secondary diagnosis, additional diagnosis, glucose test result, A1C test result, status of the medical change, diabetes medication use, number of laboratory procedures, number of medical procedures, and number of medications. The factors of healthcare utilization were time in hospital, amount of outpatient visits, amount of inpatient visits, amount of emergency visits, and medical specialty.

2.4 Data Preparation

The data was checked in terms of completeness, consistency and appropriateness to analysis. Before statistical analysis, variable formats, category labels, and coding of outcomes were studied. There were no blank missing values detected. There were however, a few categorical variables that had the entries marked Missing. These values were kept as independent categories to prevent excessive filtering out of patient records and maintain the data structure. Frequencies and percentages were used to summarize categorical variables, whereas the numerical and count-based variables were summarized using descriptive statistics measures.

2.5 Statistical Analysis

The demographic, clinical, and healthcare utilization profile of diabetic patients were summarized with the help of descriptive statistics. Categorical variables were represented by frequencies and percentages, and numerical variables by mean, standard deviation, minimum, and maximum. Chi-square test of independence was employed to test the associations between categorical variables and the hospital readmission status. In the case of numerical and count-based variables, proper group comparison tests were conducted to compare readmission and non-readmission groups. Because the variables inpatient visits, outpatient visits, emergency visits, number of procedures and number of medications are count-based, independent sample t-test was deemed appropriate in cases where normality had been violated. The level of statistical significance was measured at $p < 0.05$.

3. Results

3.1 Dataset Profile and Overall Readmission Status

The sample consisted of 25,000 records of diabetic patients and 17 variables were used to describe the demographic profile of the sample, clinical characteristics, healthcare utilization, and readmission to the hospital. Out of the total number of patients, 11,754 were readmissions, which constituted 47.02% and 13,246 were non-readmissions, which constituted 52.98%. This shows that almost half of the records of diabetic patients were related to hospital readmission, indicating that clinical importance of looking at factors related to readmission outcomes is relevant as demonstrated in Table 1 and Figure 1.

Table 1. Overall hospital readmission status among diabetic patients

Readmission status	Frequency	Percentage
Not readmitted	13,246	52.98%
Readmitted	11,754	47.02%
Total	**25,000**	**100.00%**

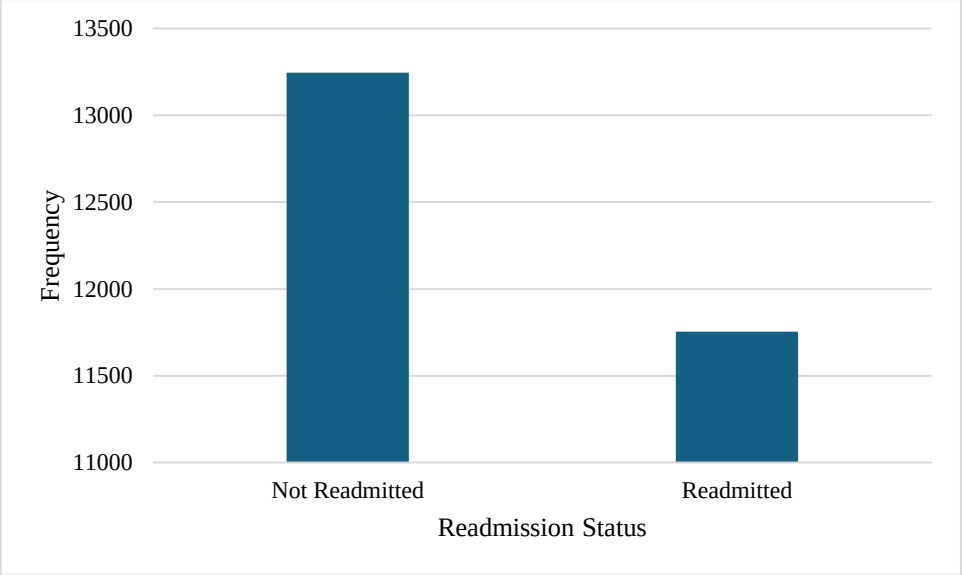

Figure 1. Distribution of hospital readmission status among diabetic patients

3.2 Clinical Factors Associated with Hospital Readmission

Clinical characteristics had significant differences in readmission rates. The highest readmission rate was noted in patients aged 80-90 years with 49.58% and then aged 70-80 years with 48.79%. Patterns of diagnosis also were significant. The highest readmission rate of 53.63% was recorded in patients with diabetes as the primary diagnosis, then it was respiratory conditions with 49.08% and circulatory conditions with 47.93%. It was also pertinent to medication related reasons with patients experiencing medication change being at a higher readmission rate (49.35%) compared to those without medication change (45.02%). Table 2 also shows that patients who were given diabetes medication had a high readmission rate (48.72%) compared to patients who were not given diabetes medication (41.35%).

Table 2. Clinical factors and readmission patterns among diabetic patients

Clinical factor	Category	Total	Readmitted	Readmission rate
Age	40–50 years	2,532	1,127	44.51%
Age	50–60 years	4,452	1,966	44.16%
Age	60–70 years	5,913	2,770	46.85%
Age	70–80 years	6,837	3,336	48.79%
Age	80–90 years	4,516	2,239	49.58%
Age	90–100 years	750	316	42.13%
Primary diagnosis	Diabetes	1,747	937	53.63%
Primary diagnosis	Respiratory	3,680	1,806	49.08%
Primary diagnosis	Circulatory	7,824	3,750	47.93%
Primary diagnosis	Digestive	2,329	1,105	47.45%
Primary diagnosis	Other	6,498	2,932	45.12%
Medication change	Yes	11,503	5,677	49.35%
Medication change	No	13,497	6,077	45.02%
Diabetes medication	Yes	19,228	9,367	48.72%
Diabetes medication	No	5,772	2,387	41.35%

3.3 Healthcare Utilization Factors and Readmission

Healthcare utilization factors showed the strongest visible relationship with readmission. Prior inpatient visits demonstrated a clear increasing pattern: patients with no prior inpatient visit had a readmission rate of **39.86%**, while those with **three or more prior inpatient visits** had a readmission rate of **75.68%**. Emergency visits showed a similar pattern, with readmission increasing from **45.07%** among patients with no emergency visit to **71.11%** among those with two or more emergency visits. Outpatient visits were also associated with higher readmission, increasing from **44.41%** in patients with no outpatient visit to **61.89%** among those with two or more outpatient visits. These findings are shown in **Table 3** and **Figure 2**.

The most visible relationship with readmission was found with healthcare utilization factors. There was a definite upwards trajectory in prior inpatient visits: a readmission rate of 39.86% in patients who had no

previous inpatient visit, and 75.68% in those who had three or more previous inpatient visits. The same was observed in the case of the emergency visits, whereby readmission rates rose to 71.11% of patients that received 2 or more emergency visits, compared to 45.07% of patients that received no emergency visits. The higher readmission was also linked with outpatient visits, where the percentage of readmission was increasing between 44.41% in the patients that never visited outpatient to 61.89% in patients that had two or more outpatient visits. Table 3 and Figure 2 present these findings.

Table 3. Healthcare utilization factors and hospital readmission rate

Healthcare utilization factor	Category	Total	Readmitted	Readmission rate
Prior inpatient visits	0	16,537	6,592	39.86%
Prior inpatient visits	1	4,926	2,696	54.73%
Prior inpatient visits	2	1,909	1,234	64.64%
Prior inpatient visits	3 or more	1,628	1,232	75.68%
Emergency visits	0	22,272	10,037	45.07%
Emergency visits	1	1,842	1,087	59.01%
Emergency visits	2 or more	886	630	71.11%
Outpatient visits	0	20,859	9,263	44.41%
Outpatient visits	1	2,076	1,213	58.43%
Outpatient visits	2 or more	2,065	1,278	61.89%

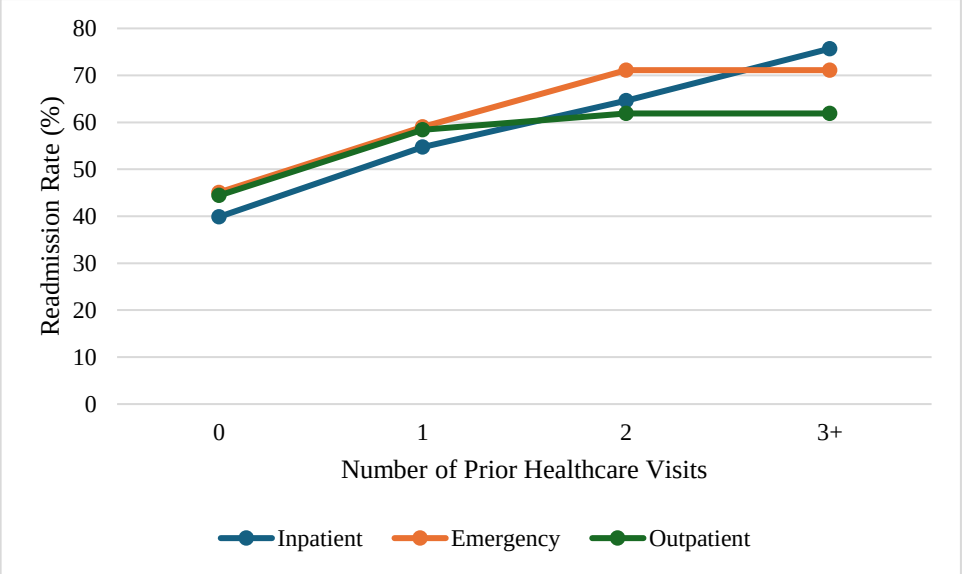

Figure 2. Readmission rate according to prior healthcare utilization

3.4 Statistical Association Between Study Variables and Readmission

Inferential statistics indicated statistically significant relationships between a number of clinical and healthcare utilization variables and hospital readmission. The Chi-square test revealed statistically significant differences in terms of age, medical specialty, primary diagnosis, secondary diagnosis, additional diagnosis, glucose test result, A1C test result, medication change, and diabetes medication status. Of these, the statistical significance of diabetes medication, medical specialty, primary diagnosis, medication change, and age was quite strong. Table 4 shows these results.

Table 4. Chi-square analysis of categorical variables associated with readmission

Variable	Chi-square value	df	p-value	Interpretation
Age	48.79	5	<0.001	Significant
Medical specialty	85.51	6	<0.001	Significant
Primary diagnosis	84.91	7	<0.001	Significant
Secondary diagnosis	33.14	7	<0.001	Significant
Additional diagnosis	45.78	7	<0.001	Significant
Glucose test	7.75	2	0.021	Significant
A1C test	14.83	2	0.001	Significant
Medication change	46.51	1	<0.001	Significant

Diabetes medication	96.26	1	<0.001	Significant

3.5 Comparison of Numerical Clinical and Utilization Variables by Readmission Status

Readmission patients had greater mean scores of a number of clinical and utilization-related variables. The average length of stay at the hospital was higher among readmission patients (4.59 days) compared to non-readmission patients (4.33 days). They also experienced a bit more average laboratory procedures and number of medications. The most significant disparities were noted in the previous use of healthcare. Readmission patients had higher mean inpatient visits (0.88) than non-readmission patients (0.38) and emergency visits were also higher among readmission patients (0.27) compared to non-readmission patients (0.11). The differences confirm the observation that the readmission status is closely linked to the previous use of healthcare as indicated in Table 5 and Figure 3.

Table 5. Comparison of numerical variables by readmission status

Variable	Not readmitted Mean ± SD	Readmitted Mean ± SD	p-value
Time in hospital	4.33 ± 3.00	4.59 ± 3.00	<0.001
Laboratory procedures	42.63 ± 20.09	43.93 ± 19.49	<0.001
Medical procedures	1.42 ± 1.75	1.27 ± 1.68	<0.001
Number of medications	15.97 ± 8.45	16.57 ± 7.58	<0.001
Outpatient visits	0.26 ± 0.93	0.49 ± 1.43	<0.001
Inpatient visits	0.38 ± 0.82	0.88 ± 1.43	<0.001
Emergency visits	0.11 ± 0.55	0.27 ± 1.15	<0.001

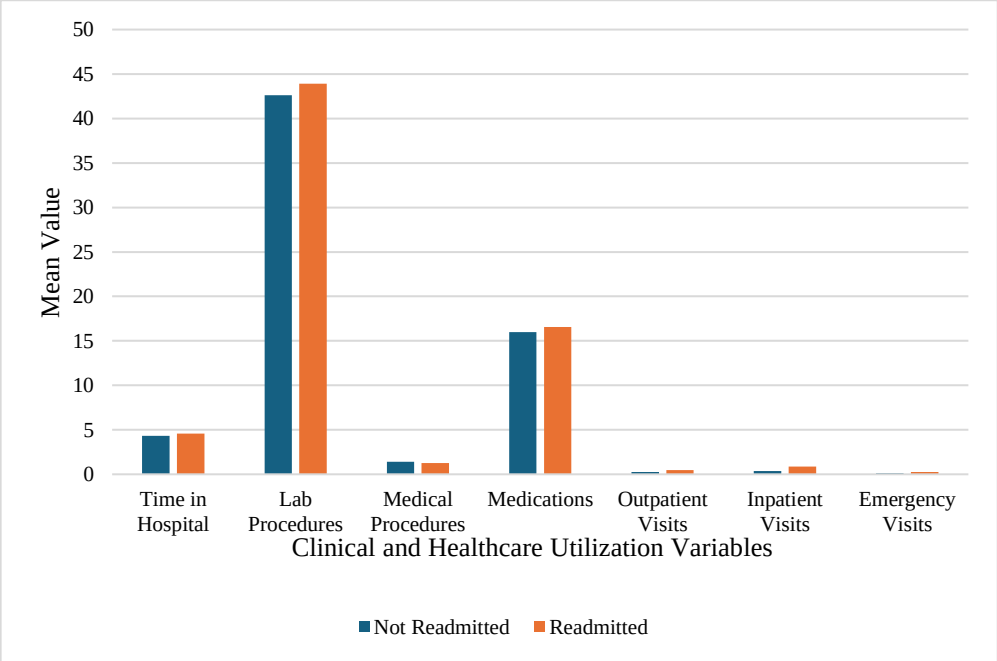

Figure 3. Mean comparison of clinical and healthcare utilization variables by readmission status

4. Discussion

The results of this study show that readmission in diabetic patients in hospitals is determined by both clinical and healthcare utilization determinants. Almost 50 percent of the patients in the dataset were readmitted, implying that readmission has continued to be a significant issue in diabetic care. This result aligns with the existing evidence that diabetes is characterized by a significant readmission burden because of its chronic nature, high incidence of complications, comorbidity, and the necessity to undergo continuous clinical supervision (Soh et al., 2020). The readmission rate was quite high in this study, and it is necessary to reinforce discharge planning, follow-up care, medication monitoring and early detection of the patients at higher risk of rehospitalization.

There was a significant relationship between age and readmission with older patients having increased readmission rate; specifically 70-80 and 80-90 years. This trend could be explained by the higher multimorbidity, frailty and complexity of medication and diminished physiological reserve in older diabetic patients. Older patients may need more extensive post-discharge care and may find it more challenging to control their blood sugar levels, adhere to medication and implement lifestyle changes following

hospitalization. Subsequent reviews have also highlighted the fact that diabetes-related readmission is multifactorial and is usually determined by the age, burden of comorbid diseases, inpatient complications, and the continuity of care post-discharge (Kukde et al., 2024). Thus, age must be taken into consideration as a key factor to develop readmission reduction strategies in diabetic patients.

The research also discovered that hospital readmission was linked to diagnosis category. The highest readmission rate was in patients with diabetes as the primary diagnosis, then respiratory and circulatory conditions. This is an indication that patients who are hospitalized mainly because of complications caused by diabetes may constitute a more unstable population. Moreover, the high patient readmission rates in respiratory and circulatory patients reveal the significance of comorbid diseases in diabetic patients. Diabetes often has cardiovascular, renal, and respiratory diseases, and these diseases might make discharge recovery challenging. There is also evidence that readmission risk is highly affected by underlying clinical severity and comorbid disease patterns, which supports the further applicability of diagnosis-based risk stratification to chronic disease management (Tay et al., 2021).

Factors related to medication were also pertinent. The readmission rate of patients who underwent medication change as compared to those who did not undergo medication change was higher and the readmission rate of patients taking diabetes medication as compared to those not taking diabetes medication was higher. These results are probably indicative of an underlying disease severity and not a direct cause of taking medication. Instead, medication use and medication change can tell about more serious disease, unstable glycemic control or the necessity of treating changes in the course of hospitalization. Complexity of medications may also lead to more risk of poor adherence, adverse effect, and post-discharge misunderstanding. These results indicate the necessity of systematic medication reconciliation, patient counselling and post-discharge follow-up. Patient and caregiver awareness is relevant in this situation since the evidence of awareness that is taken into consideration to enhance treatment adherence, timely follow-up, and health-seeking behavior may be offered by various healthcare groups (Saleh et al., 2023).

The strongest relationship with readmission was observed with healthcare utilization factors. There was a significant readmission rate among patients who had previously had an inpatient visit and the readmission rate increased as the number of previous inpatient visits increased with a readmission rate of 39.86% when the number of previous visits were no more than three. There were also increasing trends of readmissions through emergency visits and outpatient visits. These results indicate that past healthcare utilization is an excellent predictor of patient instability and continued healthcare requirement. Repeated previous hospitalizations and emergencies can indicate poorly managed disease, unmanaged complications, poor outpatient care or continuity of care barriers. An earlier study on 30-day readmission risk of diabetic patients also showed that the risk of readmission depends on a variety of clinical and utilization-related factors, which underlines the significance of the hospital encounter history as a tool to identify a high-risk patient (Shang et al., 2021).

The fact that numerical variables are compared also supports this interpretation. The average time in hospital, laboratory, medications, outpatient, inpatient visits, and emergency visits of readmissions were more. An extended hospital stay can be a pointer of increased severity of illness or complication during hospitalisation. Possibly, more complicated clinical management is also demonstrated by increased laboratory processes and medications. Notably, the greatest changes were observed in previous inpatient and emergency visits, which implies that utilization history can be a more viable source of information than certain clinical measures. Clinical severity, comorbidity, and factors related to hospitalization also revealed similar evidence among hospitalized adults with diabetes or stress hyperglycemia after COVID-19 hospitalization that readmission and mortality are shaped (Chaugule et al., 2024).

The statistical test validated the fact that readmission was significantly associated with a number of variables such as age, medical specialty, diagnosis categories, glucose test, A1C test, medication change, and diabetes medication status. The importance of glucose and A1C measurements implies that glycemic measurement is still pertinent in the assessment of readmission risk. Nevertheless, the existence of test results is to be taken with a grain of salt, because testing can also be more prevalent among those patients who have more complicated or inadequately treated diabetes. Recent predictive analyses have also found that readmission rate in diabetes patients is a combination of demographic, clinical, lab, and healthcare utilization data, but the current research was statistically correlated and not machine-learned to predict (Liu et al., 2024).

The results have a clinical care and healthcare management implication. Discharge planning, medication review, diabetes education and early post-discharge follow-up should be prioritized to patients with repeated inpatient or emergency visits. Hospitals can also consider the creation of readmission screening procedures, which comprise of age, diagnosis, change of medication, use of diabetes medication, length of stay and previous healthcare usage. Readmission risk can be even more complicated in the case of diabetic patients with renal or fluid-related issues since the renal kidney disease and fluid overload were identified as significant factors in

repeated hospitalization (Cai et al., 2024). Thus, the care given by physicians, nurses, pharmacists, diabetes educators, and follow-up coordinators can contribute to a decrease in preventable readmissions.
Overall, this research demonstrates that the issue of hospital readmission of diabetic patients cannot be attributed to one factor. Rather, readmission seems to relate to a complex of clinical complexity, medication-related predictors, diagnostic load, and previous healthcare use. Previous inpatient and emergency visits showed the strongest practical signal and it is presumed that the hospital encounter history should be viewed as one of the warning signals. These results justify the importance of effective discharge planning and continuity-of-care interventions to diabetic patients with greater readmission risks.

5. Conclusion

This study analyzed the clinical and healthcare use variables related to hospital readmission of diabetic patients using a structured data set. The results show that readmission at the hospital is a serious issue, and almost half of the patients underwent readmission. This underscores the current issues of providing effective management of diabetes and continuity of care beyond the hospital setting. The findings indicate that the clinical features and healthcare usage patterns are significant in readmission. The clinical factors that were related to readmission rates variation included age, primary diagnosis, medication use, and medication changes, implying that the severity of the disease and complexity of the treatment are related to patient outcomes. The relatively high readmission rates were found in patients with diabetes as the primary diagnosis and in patients who were changing medication, which suggests that they should be monitored more closely and planned to receive better treatment. Factors that were found to have the greatest impact on readmission are healthcare utilization factors. There was a positive progressive pattern in the readmission rates with more visits of the kind through prior inpatient, emergency and outpatient visits. This indicates that patients who experience frequent healthcare encounters are a high-risk group that is experiencing clinical instability or unmet care needs. Moreover, prolonged hospitalization and greater utilization of healthcare services were also linked to readmission probability, which also confirms the significance of proper discharge planning and follow-up. Comprehensively, the research underscores that hospital readmission in diabetic patients is multifactorial and both clinical complexity and historical healthcare use is a determinant in the process. Determining high-risk patients on the basis of these variables can aid in interventions, better patient management, and better use of healthcare resources. Enhancing the discharge procedures, patient education, and follow-up plans could contribute to the decrease in avoidable readmissions and overall outcomes in diabetic care.

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