Original Research

ECONOMIC COSTS OF HOSPITALIZATION AND LENGTH OF STAY IN DIABETES WITH CO-EXISTING HYPERTENSION WITH CORRELATION TO LABORATORY INVESTIGATIONS: WHERE DOES INDIA STAND? A FIVE YEARS GROUND REPORT

Abstract

Introduction: The coexistence of diabetes mellitus (DM) and hypertension (HTN) worsen clinical outcomes and contribute to increased morbidity and mortality.

Objective: This study aims to analyze the length of stay and healthcare costs by calculating the direct and indirect costs of diabetes with co-existing hypertension in North India.

Methods: A prospective observational study was conducted at the medicine department of the three different hospitals.

Results: The patients' mean age was found to be (M=53.8, SD=11.5) years. Out of 1914 patients, 53.65% were found female. Our study revealed that the median cost of medical supplies and equipment was found to be 21.2 $. The median cost of dialysis was found at 47.5 $; the median cost of hospitalization was found to be 142.6 $. The treatment's median direct cost was 188.5 $, followed by the overall median cost of 295.6 $. The maximum overall cost of treatment was observed at 603.9 $. It was observed that that maximum LOS was found to be 14 days for patients having BPS between 140 to 159 mmHg and BPD between 110- 119 mmHg, and minimum LOS was found to be 3.5 days.

Conclusion: The present study highlighted that diabetes co-existing hypertension poses a high economic burden on patients. This study explored that highly significant result for BPS, BPD, FBS, and HbA_1c, whereas the significant results were obtained when RBS is compared with LOS and treatment costs. Our study concluded that mean difference of 9.24 $ in patients having FBS: 261-290 mg/dl and > 290 mg/dL. The LOS increases 6.57 days for patients with BPS between 140-159 mmHg compared to BPS between 180 -above 209 mmHg, which lower treatment costs -21.31$.

Keywords: Diabetes, Hypertension, length of stay, cost of treatment, direct medical cost, indirect medical cost

Highlights

What is already known about the topic?

- The median direct cost of diabetes alone was estimated to be ₹18,890/- p.a. (257.5 $) for the North Indian population as per the literature available. As per our study results, for in-patients admitted due to diabetes with co-existing hypertension, the median direct cost of hospitalization cost is 188.5 $.

What does the paper add to existing knowledge?

- The present study is the first study conducted on in-patients admitted due to diabetes with co-existing hypertension in selected regions of North India on LOS and treatment cost in the hospital to the best of our knowledge and literature available.
- This study describes the economic and clinical impact of diabetes mellitus with co-existing hypertension. A highly significant correlation of BPS, BPD, FBS, RBS, and HbA_1c on admission with the length of stay in days & overall cost of the treatment (direct and indirect costs) were observed.

- The study adds to existing literature that the maximum length of stay in hospital was 14 days, and the maximum treatment cost of diabetes with co-existing hypertension was 603.9 $.
- The LOS increases 6.57 days for patients with BPS between 140- 159 mmHg compared to BPS between 180- above 209 mmHg, which lower treatment costs by -21.31$. The LOS lowers by -3.97days for patients with BPD less than 80 mmHg compared to BPD >120 mmHg with an increase in treatment costs of 11.85$. Our study concluded that LOS lowers by -2.8 days for patients with HbA1c levels less than 42 mmol/mol compared to HbA_1c levels more than 48 mmol/mol, whereas the treatment cost increases by 5.86 $.
- Our study findings and recommendations will fill the gap in scientific knowledge, which will help Indian government decision-making and its use in policy formulation and implementation in pharmacoeconomics related areas.

1 Introduction

The coexistence of diabetes mellitus (DM) and hypertension (HTN) worsen clinical outcomes and contribute to increased morbidity and mortality[1]. Both DM and HTN are important risk factors for cerebrovascular disease, heart failure, and coronary artery disease (CAD)[2]. Hypertension is a prevalent comorbid condition in diabetes, affecting ~20–60% of patients with diabetes, depending on obesity, ethnicity, and age[2]. Both DM and HTN present considerable challenges in developing countries like India[3]. The presence of hypertension, particularly with diabetes mellitus leading to target organ damage and associated with renal disease risk, substantially increases the risk of (CVDs) cardiovascular risk disease[4]. CVDs are the leading causes of death as of 2015. In 2012, it claimed that an estimated 17.5 million people died due to CVDs, a share of 31% of all the global deaths worldwide[5]. India is a developing country with a population of approximately 1.3 billion[5]. The present study was conducted to determine the length of stay, average medical and non-medical treatment costs incurred by patients suffering from diabetes mellitus (type-I and type-II) with co-existing hypertension. The present study has been divided into two sections. The first section deals with patients demographic as well as lab parameters evaluated. The second section deals with the correlation of lab investigations like fasting blood sugar (FBS) in mg/dL, random blood sugar (RBS) in mg/dL, HbA1c (%), blood pressure systolic (BPS), blood pressure diastolic (BPD), serum creatinine, serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) level in IU/L of the patient on admission were recorded during the study with length of stay and treatment cost.

2 Methods

2.1 Study design

A prospective observational study

2.2 Setting

All the hospitalized patients referred to the medicine department of the three different hospitals located in Moga, City Punjab

2.3 Participants

All diabetes mellitus (type-I and type-II) with co-existing hypertension patients were asked to participate in the study. The current paper is part of the ongoing study. Patients diagnosed with diabetes mellitus and hypertension with or without complications are admitted to the (IPD) in-patient department. The study's inclusion criteria include patients visiting the hospital for follow-up, both genders with age >18 years, and diabetes and hypertension. The exclusion criteria include that patients were not willing to participate in the study.

2.4 Sample size

The sample size is calculated with the 'Epi Info' software[6,7]. A total of 2622 patients suffering from diabetes mellitus (DM) and hypertension (HTN) were screened during the study period from November 2015 to August 2020. Out of the 2622 patients, 1914 patients were enrolled in the statistical analysis. A total of 708 patients were excluded while analyzing because of missing data; some patients were lost during the follow-up. Thus, a total sum of 1914 patients was included in the final analysis.

2.5 Variables

The lab investigations like fasting blood sugar (FBS) in mg/dL of the patient,

random blood sugar (RBS) in mg/dL of the patient, HbA1c in (%) of the patient, blood pressure systolic (BPS) of the patient on admission, blood pressure diastolic (BPD) of the patient on admission, serum creatinine, Serum glutamic oxaloacetic transaminase (SGOT) and Serum glutamic pyruvic transaminase (SGPT) level in IU/L were recorded during the study. A pre-developed and validated tool (DCF and PIC) data collection form and patients' informed consent was used to collect patient data.

2.6 Ethical approval

Institutional Ethics Committee of ISF College of Pharmacy, Moga, Punjab approved the study (Ref. No. ECR/296/Indt/PB/2017/ISFCP/136).

2.7 Statistical methods

The confidence interval of the study was selected as 97%. All statistical tests were carried out at the two-sided 3% significance level by statistical analysis software SPSS ver. 25. The study data collection form includes a questionnaire containing 105 variables.

3. Results

The mean age of the patients suffering from diabetes mellitus (type-I and type-II) with co-existing hypertension (μ) and standard deviation (SD) was found to be (M = 53.85, SD = 11.54) years as compared to a study conducted by Islam MR *et al.,* (2017) mean age of the patients 44.5 years[8]. The normality test was performed for the overall cost of the treatment, was found normally distributed Kolmogorov-Smirnov and Shapiro-Wilk (*p=0.20 and 0.19*), respectively[9]. Out of 1914 patients, 914 patients were found a male (47.8%), followed by female patients 1000 (53.65%) as compared to study conducted by Mandal S *et al.,* (2016) 38.67% female patients[10].

During the study, it was found that only 17 % of the patients have personal health insurance cover and only three percent of the patients have medical expenses covered by their employers and place of work. 80 % of the patients did not have any insurance or health cover; they have to bear all treatment costs independently. The median per annum income of the patients was found to be 1854 $. During the study, it was found that 496 (26%) of patients having a median per annum income above 6800 $ simultaneously, 282 (14.8%) of the patients were found unemployed.

In our study mean body mass index (BMI)was found to be (M= 31.13,SD = 5.51)kg/m^2.On evaluating BMI, it was found that only 3 (0.2%) of the patients were found underweight with BMI less than18.5 kg/m^2 followed by 270 (14.1%) patients having the normal weight and BMI18.5 - 25 kg/m^2. The 571 (29.8%) of the patients were having BMI between 25.1 - 30 kg/m^2 considered overweight, whereas the maximum patients 1070 (55.9 %) were having BMI above 30 kg/$m^{2,}$ which are considered obese per the Centers for disease control guidelines, Body Mass Index: Considerations for practitioners[11,12]. Our study's BMI results are compared with a study conducted by Abougalambou S *et al.* (2010) reported that 81.5 % of the patients having a BMI above 23 kg/$m^{2,}$[13].

The patients' blood glucose profile was recorded during the study period from the patients' case sheet. The tests include fasting blood sugar (FBS), random blood sugar (RBS), HbA1c of the patient during admission. The normality Kolmogorov-Smirnov[a] (K-S) test and Shapiro-Wilk[b] test were conducted to determine the patients' normality distribution[14]. In this test results, the null hypothesis states that the data follow an $N(\mu, \sigma^2)$ normal distribution. Both the variable FBS and RBS were normally distributed with (*p= 0.114* and *p= 0.200*).All statistical tests' significance level is considered as *0.03,* with a confidence level of 97% [9,15].

The majority of patients having fasting blood sugar (FBS) between 261-290 mg/dl that is 1480 (77.3%) patients followed by 293 (15.3%) patients were having FBS between 231-260 mg/dl and only 141 (7.4%) patients had FBS above 290 mg/dL. The similar results were obtained in other studies conducted in

The majority of patients having random blood sugar (RBS) above 290 mg/dL 1843 (96.3 %) patients, followed by 71 (3.7%) patients were having RBS between 261-290 mg/dL. The almost similar results were reported by Kasi J *et al.* (2014) in India[16] and Kide S *et al.* (2014)[17]. Kide S *et al.* (2014) concluded in his study that diabetes was associated with low awareness of diabetes in Wardha region[17].

The mean level of HbA_1c was found to be M=7.90, SD = 1.60 (Unit of HbA_1c= percentage)with a minimum HbA_1c 5.60 (%), and maximum was found 10.0 (%) as compared to mean HbA_1c (6.7%) reported by Alam MS *et al.* (2014) in New Delhi[18] followed by (9.56%) reported by Kalk W J *et al.* (2010) in South Africa[19].

During the study, it was observed that maximum patients have an SGOT level between 10-20 IU/L, i.e., 729 (39.10 %) followed by 21-30 IU/L 499 (26.1%). SGOT and SGPT test was not conducted for 248 (13%) patients out of 1914. The maximum number of patients (95.3%) had serum creatinine levels between 1.4 and 2.5 mg/dL as compare 0.55 reported by Broberg M *et al.* (2020) in Cleveland, OH, USA[20].

The direct non-medical cost calculates the transport cost, cost of a special diet, and another pocket expenses. In contrast, the direct medical cost is calculated by taking the sum of medical supplies and equipment, cost of diagnostic tests, cost of dialysis, and hospitalization costs. The overall cost is calculated by direct non-medical cost +direct medical cost. The cost is recorded in INR, and then data is converted in $ (1$=73.35 ₹) as data of cost was found normally distributed for overall all cost of the treatment, whereas the direct cost was found not normally distributed. Thepharmacoeconomicdata of cost of medical supplies and equipment (CME), cost of diagnostic tests (CDT), cost of dialysis /per session (CD), cost of hospitalization (CH), direct medical cost (DMC), cost of transport (CT), cost of special diet (CSD), another pocket expenses (APE), direct non-medical cost (DNMC), indirect non-medical cost-loss of income (INMC), the overall cost of the treatment (OCT) and overall cost of the treatment per day (OCT/PD) is represented in ***Table 1.***

All costs are reported in mean and standard deviation for normally distributed variables and median and IQR for not normally distributed variables. In our study, the overall median cost of treatment was found to be 295.6 $ as compared to 444.62 $ reported by Gajdos O *et al.* (2015)in the Czech Republic[21], 1912$ by Malone M *et al.* (2015) in Australia[22], 118.8 $ by Eshwari K *et al.* (2019) in India[23].

In our study, diagnostic tests' cost in patients with DM and HTN was found to be 14.8 $ compared to the 7.71 $ previous study conducted by Agrawal A *et al.* (2017) in India[24] and 24.31$ reported by Moucheraud C *et al.* (2019) in India[25]. Almost the difference of (7.09$ and 9.51 $) half is observed[24]. In our study, the median cost of hospitalization was found to be 142.6 $ as compared to 159.72 $ reported by Chen D *et al.* (2017) in Hubei Province, China[26]. We reported the median cost of dialysis 47.5 $ as compare to 2 $ in government hospitals and 27.26 $ in private hospitals by Khanna U *et al.* (2009) in India. The difference of 20.24$ is observed because of the difference of one decade in both the studies[27].

In our study, the median direct cost of the treatment was 188.5 $ compared to a systemic review of thirty-two studies conducted by Oberoi S *et al.* (2020) was estimated to be 257.5 $ per annum for the North Indian population[28]. A difference of -66 $ was observed in both the studies. Our study data releveled that the median cost of medical supplies and equipment used in treatment was found to be 21.2 $ as

compared to 17.2$ study reported by Biswas A *et al.* (2026) in Indian population for diabetes alone[5].

The maximum overall cost of treatment was found to be 603.9 $, followed by the minimum overall treatment cost of 29.2 $. The Grover S *et al.* (2005) reported maximum treatment cost 263.7 € = 312.7$[29]. The difference of 291.2 $ observed in both studies because a gap of 15 years between both the studies[29]. The treatment's minimum direct medical cost was 56.8 $, followed by the maximum direct medical cost of treatment found to be 386.5 $.

During the study, it was also observed that smoking history was associated with a longer duration of stay by β= 2.22 days, *p=0.01,* with higher hospitalization costs β= 112$. Similar results were obtained in the study reported by Naser AY *et al.* (2020) for LOS, but opposite results were reported for hospitalization costs[30].

During the study, it was observed that fasting blood sugar (FBS) level on admission was found in between 231-260 mg/dl in 293 patients, and the mean cost of overall treatment was found to be (M=61.03, SD=36.06) USD followed by 261-290 mg/dl in1480 patients (M=54.72, SD=38.04) USD and above 290 mg/dL in 141 patients (M=45.48, SD=17.12) USD. One-way Anova was performed to compare the overall cost of treatment in different fasting blood sugar levels on admission. There was a significant effect of fasting blood sugar on the overall treatment cost [F (2,1911) = 8.78, *p=0.001*]. The post hoc comparison using Tukey HSD indicated that a mean difference of 6.31 $ was found between FBS: 231-260 mg/dl and 261-290 mg/dl (p=0.19), whereas the mean difference of 15.55 $ was observed in FBS: 231-260 mg/dl and > 290 mg/dL (*p=0.001)*. The results also indicate the mean difference of 9.24 USD in between FBS: 261-290 mg/dl and > 290 mg/dL (*p=0.012*). The mean difference is considered significant at the 0.03 level. ***Figure 1*** shows the comparisons of the overall cost (INR) of the treatment with FBS and RBS of the patients.

On the evaluation of random blood sugar (RBS) level on admission with the overall cost of the treatment per day, it was found that the majority of the patients 1843 having RBS above 290 mg/dL, and the mean overall cost of the treatment per day found to be (M=54.12, SD=35.23) $ followed by RBS between 261-290 mg/dL in 71 patients (M=78.10, SD= 60.80) $. One-way Anova was performed to compare the overall cost of treatment in different categories of random blood sugar levels on admission. There was a significant effect of random blood sugar on the overall treatment cost [F (1,1912) = 29.56, *p=0.001*].

In most patients, 1763 (92.11%), having HbA_1c (%) level 48 mmol/mol (6.5% or over) during admission, indicating and confirming diabetes. The only 111(7.89%) patients with HbA_1c (%) between 42 - 47 mmol/mol (6.0 to 6.4%) are prediabetes. On the evaluation of the hypertensive profile of the patients, it was observed that blood pressure systolic (BPS) distribution on admission majority of the patient 1787 (93.36 %) having BPS in between 180-209 and above mmHg representing stage III hypertension as compare to mean BPS above 140 mmHg reported by Abiodun O *et al.* (2014) in all patients in Nigeria[31].

In contrast, the blood pressure diastolic (BPD) distribution of the patient on admission most of the 755 (39.4%) patients having BPD in between 100 - 109 mmHg represents stage-II hypertension[32,33] followed by 654(34.16%) patients having BPD in between 90 - 99 mmHg represent stage-I hypertension[34]. The author Kadima J *et al.* (2018) reported that 57.7% of patients with BP values higher than BPS: 180 and BPD: 110 mmHg (stage-I) in Bukavu, Congo[35].

Only 25 (1.3%) patients have BPS above 220 mmHg representing hypertensive crisis[36]. The author Spain L *et al.* (2012) reported a case study on hypertensive

crisis patients precipitated by insulin reported BP 170/90 mmHg, which can lead to end-stage renal failure[37].

The data of lab values and SPSS codes given are represented in ***Table 2.*** ***Figure 2*** scatterplot matrix represents the correlation of variables like the BP systolic, BP diastolic of the patient during admission with the overall cost of the treatment.

The General Linear Model (GLM) One-Way Manova (Multiple Analysis of Variance) was performed to find out the effect of systolic blood pressure, diastolic blood pressure, fasting blood sugar, random blood sugar, HbA_1c on admission with the length of stay in days & overall treatment cost per day.

The descriptive statistics of GLM: BP systolic & BP diastolic of the patient on admission with the length of stay (LOS) in days revealed that maximum length of stay in days (M=14.0, SD= 0.01) days was observed in one patient having BPS between 140 to 159 mmHg and BPD between 110- 119 mmHg followed by (M=9.04, SD=2.96) days in 25 patients having BPS between 180 to 209 mmHg and BPD between >120 mmHg. The minimum means LOS was found (M=3.50, SD=2.38) days in 04 patients had BPS between180- 209 mmHg and BPD between < 80 mmHg. For most patients 744, the mean LOS was found to be (M=6.71, SD=2.15) days having BPS between 180 to 209 mmHg and BPS between 100 - 109 mmHg represented in ***Table 3.*** The maximum LOS observed 14 days, followed by nine days, is compared with a study conducted by Agrawal A *et al.* (2017) reported 4.01 days[24]. Malone M *et al.* (2014) and Chen D *et al.* (2017) reported mean LOS ten days [22],[26]

The difference of 10 days followed by five days was observed between our study and the study conducted by Agrawal A *et al.* (2017). The estimated marginal means of the overall cost of the drug with BP systolic of the patients on admission shown in ***Figure 3***

The descriptive statistics of GLM: BP systolic & BP diastolic of the patient on admission with the overall cost of the treatment per day (OCT/PD) revealed that maximum OCT/PD was found in 22 patients (M=100.21, SD=104.84) $ in-patient having BPS between 160 to 179 mmHg and BPD between 85 - 89 mmHg. The minimum OCT/PD was observed in one patient (M=31.19, SD=0.01) $ patient having BPS between 140 to 159 mmHg and BPD between 110- 119 mmHg. For most patients 744, the mean OCT/PD was found to be (M=54.99, SD=37.33) $ having BPS between 180 to 209 mmHg and BPD between 100 - 109 mmHg as represented in ***Table 3.***

The descriptive statistics of FBS at admission, RBS at admission, and HbA_1c on admission with the length of stay in days revealed that maximum mean length of stay was found (M=8.55, SD= 2.78) days observed in 141 patients having FBS above 290 mg/dL, RBS above 290 mg/dL, and HbA_1c 48 mmol/mol (6.5% or over) followed by mean length of stay (M=6.66, SD=2.21) days in 1741 patients having FBS above 290 mg/dL, RBS above 290 mg/dL, and HbA_1c 48 mmol/mol (6.5% or over) as total. The minimum mean LOS was found (M=2.00, SD=0.01) days in 13 patients with FBS level between 231-260 mg/dl, RBS level between 261-290 mg/dL HbA_1c level average or below 42 mmol/mol (6.0%) as represented in ***Table 4.***

The descriptive statistics of FBS at admission, RBS at admission, and HbA_1c levels on admission with the overall treatment cost per day revealed that the maximum mean OCT/PD was found in 13 patients (M=152.53, SD= 114.38)$ having FBS between 231-260 mg/dl, RBS between 261-290 mg/dL and HbA_1c level below 42 mmol/mol (6.0%) followed by (M=132.66, SD=97.10)$ in 20 patients having FBS level between 231-260 mg/dl, RBS level above 290 mg/dL and HbA_1c level below 42 mmol/mol (6.0%). The minimum OCT/PD was observed in 204 patients (M=51.41, SD=15.22) $ patients with HbA_1c level above 48 mmol/mol (6.5% or over), indicating

diabetes as shown in ***Table 4*** and ***Figure 4*** simple 3-D scatter plot of the overall cost of the treatment per day (INR) with HbA_1c of the patient during admission by the length of stay in days.

The parameter estimates ***Table 5*** length of stay in days,and overall cost of treatment revealed that most of the categories of the blood pressure distribution (BPS and BPD) of the patient at admission (140 to 159 mmHg- *p= 0.01*, 160 to 179 mmHg- *p= 0.03*, 180 to >209 mmHg- *p=0.01*) were found significant. The LOS increases β= 6.57 days for patients with BPS between 140 and 159 mmHg compared to BPS between 180 to >209 mmHg with lower treatment costsβ= -21.31 $. The data of most categories of BPD distribution of the patient at admission was found significant (BPD levels less than 80 mmHg- *p= 0.01*, 80 - 84 mmHg- *p= 0.01*, 85 - 89 mmHg- p= *0.01*, 90 - 99 mmHg- *p= 0.01*, 100 - 109 mmHg- *p=0.01*, and 110 - 119 mmHg- *p=0.01*) for LOS. The non-significant results were obtained for categories of BPD with treatment cost, as shown in ***Table 5.*** The LOS lowers by β= -3.97days for patients with BPD less than 80 mmHg compared to BPD >120 mmHg with an increase in treatment costsβ= 11.85$.

The parameter estimates data of HbA_1c distribution of the patients on admission shows significant results for LOS and treatment costs (HbA_1c: < 42 mmol/ mol- p= 0.01, 42 to 47 mmol/mol-p=0.01). The data revealed that LOS lowers by β= -2.8 days HbA_1c= < 42 mmol/mol as compare to HbA_1c= > 48 mmol/mol whereas the treatment cost increases by β=5.86 $ for HbA_1c= < 42 mmol/mol and by β=3.84 $ for HbA_1c=42 to 47 mmol/mol as compare to patients having HbA_1c= > 48 mmol/mol as shon in ***Table 5.***

The parameter estimates data of different categories of fasting blood sugar distribution of the patient at admission and random blood sugar distribution of the patient at admission revealed that most of the categories were significant (FBS: 231-260 mg/dl-*p=0.01*, 261-290 mg/dl- *p=0.01*) for LOS except (RBS: 261-290 mg/dL-*p=0.397*). The fasting blood sugar distribution of the patient at admission and random blood sugar distribution at admission with treatment costs non-significant results were obtained, as shown in ***Table 5***. The data shows that LOS lowers by β=-2.66 for FBS level 231-260 mg/dl as compare to FBS above 290 mg/dL, whereas the treatment cost of treatment increase by β= 3.86$.

The Wilks' lambda, Pillai's trace, Hotelling's trace, and Roy's largest root test statistics were calculated for blood pressure systolic: *(p=0.01),* blood pressure diastolic: *(p=0.01)*, fasting blood sugar: *(p=0.01)*, random blood sugar: *(p=0.27)*, HbA_1c on admission: *(p=0.01)*with LOS and treatment costs. The highly significant were obtain for BPS, BPD, FBS, and HbA_1c, whereas the significant results were obtained in RBS with LOS and treatment costs, as shown in ***Table 6.***

Test between subject ***Table 7*** represents that independent variable like blood pressure systolic on admission, blood pressure diastolic on admission, fasting blood sugar on admission, random blood sugar on admission, and HbA_1c on admission shows highly significant results for a dependent variable length of stay in days & overall cost of the treatment per day. On evaluation of hypertensive profile of the patients it was concluded that the (BPSACAT) blood pressure systolic on admission was found highly statistically significant for length of stay in days(F (*df*= 2, 1913) = 23.67, *p= 0.001)*and overall cost of the treatment per day(F (*df*= 2, 1913) = 10.43, *p= 0.001)*. The blood pressure diastolic on admission (BPDACAT) was found statistically significant for length of stay in days (F (*df*= 2, 1913) = 22.53, *p= 0.001)* and overall cost of the treatment per day (F (*df*= 2, 1913) = 0.70, *p= 0.021)*.

On evaluation of blood glucose profile of the patients it was concluded that

the(FBSACAT)fasting blood suger on admission was foundhighly statistically significant for length of stay in days (F (*df*= 2, 1913) = 71.5, *p= 0.001)*whereas the statistically significant results were obtained for overall cost of the treatment per day (F (*df*= 2, 1913) = 3.4, *p= 0.030)*. The data of random blood suger on admission (RBSACAT)showsstatistically significant results for length of stay in days (F (*df*= 2, 1913) = 0.7, *p= 0.029)*and overall cost of the treatment per day (F (*df*= 2, 1913) = 1.8, *p= 0.027)*.The HbA_1c on admission (HbA_1cAddC) when compared with length of stay in days (F (*df*= 2, 1913) = 57.6, *p= 0.001)* and overall cost of the treatment per day (F (*df*= 2, 1913) = 59.2, *p= 0.001)*highly statistically significant results were obtained as shown in ***Table 7.***

4. Conclusion:

The mean age of the patients suffering from diabetes mellitus (type-I and type-II) with co-existing hypertension (μ) and standard deviation (SD) was found to be 53.85 years. The mean BMI (μ) and standard deviation (SD) was found to be (M= 31.13,SD = 5.51)kg/m^2. On evaluating BMI, it was found that maximum patients (55.9 %) were having BMI above 30 $kg/m^{2,}$ which is considered obese as per the Centers of disease control guidelines, Body Mass Index: Considerations for practitioners [11,12].

The majority of patients having fasting blood sugar (FBS) between 261-290 mg/dl (77.3%) patients whereas the majority of patients having random blood sugar (RBS) above 290 mg/dL (96.3 %) patients. The majority of patients having a mean level of HbA_1c 10.0 (%). During the study, it was observed that maximum patients have an SGOT level between 10-20 IU/L, i.e., (39.10 %) and SGPT test was not conducted for (13%) patients. The maximum number of patients (95.3%) had serum creatinine levels between 1.4 and 2.5 mg/dL.

Our study concluded that the median cost of medical supplies and equipment was found to be 21.2 $, followed by the cost of diagnostic tests found to be 14.8 $, the median cost of dialysis, 47.5 $, the median cost of hospitalization was found to be 142.6 $. The treatment's median direct cost was found to be 188.5 $, followed by the overall median cost of treatment 295.6 $. The maximum overall cost of treatment was 603.9 $, followed by the minimum cost overall cost of treatment 29.2 $. The treatment's minimum direct medical cost was56.8 $, followed by the maximum direct medical cost of treatment found to be386.5 $. The highly significant were obtain for BPS, BPD, FBS, and HbA_1c, whereas the significant results were obtained in RBS with LOS and treatment costs. The independent variable like blood pressure systolic on admission, blood pressure diastolic on admission, fasting blood sugar on admission, random blood sugar on admission, and HbA_1c on admission shows highly significant results for a dependent variable length of stay in days & overall cost of the treatment per day. On evaluating the hypertensive profile of the patients, it was concluded that the (BPSACAT)blood pressure systolic on admission was found highly statistically significant for the length of stay in days and overall cost of the treatment per day. The blood pressure diastolic on admission (BPDACAT) was found statistically significant for the length of stay in days, and the overall treatment cost per day.

On evaluating the patients' blood glucose profile, it was concluded that the (FBSACAT)fasting blood sugar on admission was found highly statistically significant for the length of stay in days, whereas the statistically significant results were obtained for the overall cost of the treatment per day. The random blood sugar on admission (RBSACAT)shows statistically significant results for length of stay in days and the overall treatment cost per day. The HbA_1c on admission (HbA_1cAddC) compared with the length of stay in days and overall cost of the treatment per day highly statistically significant results were obtained.

Our study concluded that in most patients, fasting blood sugar (FBS) level on admission was found between 261-290 mg/dl, and the mean cost of overall treatment was found to be 54.72 $. Our study concluded that there was a significant effect of fasting blood sugar on the overall treatment cost. The mean difference of 6.31 $ was found between FBS: 231-260 mg/dl and 261-290 mg/dl whereas the mean difference of 15.55 $ was observed in FBS: 231-260 mg/dl and > 290 mg/dL. The results also indicate the mean difference of 9.24 $ in between FBS: 261-290 mg/dl and > 290 mg/dL.

Our study concluded that in most patients having RBS above 290 mg/dL, the mean of the overall cost of the treatment per day was54.12 $. There was a significant effect of random blood sugar on the overall treatment cost. The majority of the patients with HbA1c (%) during admission 48 mmol/mol (6.5% or over) indicated diabetes.

Our study also concluded that most of the patients with blood pressure systolic (BPS) distribution on admission between 180 to 209 and above mmHg represent stage III hypertension. The BP systolic & BP diastolic of the patient on admission when compared with the length of stay (LOS) in days it was concluded that maximum length of stay in days was found to be 14 days for the patient having BPS between 140 to 159 mmHg and BPD between 110- 119 mmHg. The minimum means LOS was found 3.5 days in patients having BPS between180- 209 mmHg and BPD between < 80 mmHg.

Our study also concluded that the maximum overall cost of the treatment per day (OCT/PD) was 100.21 $for the patient having BPS between 160 - 179 mmHg and BPD between 85 - 89 mmHg.The minimum OCT/PD was 31.19 $in one patient with BPS between 140 - 159 mmHg and BPD between 110 and 119 mmHg. For most patients, the mean OCT/PD was54.99 $having BPS between 180- 209 mmHg and BPD between 100 - 109 mmHg.

Our study also concluded that the maximum mean length of stay was found 8.55 days in patients having FBS above 290 mg/dL, RBS above 290 mg/dL, and HbA_1c 48 mmol/mol (6.5% or over). The minimum means LOS was found two days in patients having FBS level between 231-260 mg/dl, RBS level between 261-290 mg/dL, and HbA_1c level average or below 42 mmol/mol (6.0%).

Our study also concluded that maximum mean OCT/PD was found 152.53 $in 13 patients having FBS between 231-260 mg/dl, RBS between 261-290 mg/dL and HbA_1c level below 42 mmol/mol (6.0%) followed by 132.66$ in 20 patients having FBS level between 231-260 mg/dl, RBS level above 290 mg/dL and HbA_1c level average: below 42 mmol/mol (6.0%). The minimum OCT/PD wasfound51.41$in patients with HbA_1c level above 48 mmol/mol (6.5% or over)in 204 patients indicating diabetes.

Our study concluded that length of stay in days and the overall cost of treatment were significant with most of the categories of the blood pressure distribution (BPS and BPD) of the patient at admission. The LOS increases 6.57 days for patients with BPS between 140 and 159 mmHg compared to BPS between 180 to >209 mmHg with lower treatment costs-21.31 $. Our study concluded that non-significant results for categories of BPD with treatment cost. The LOS lowers by -3.97days for patients with BPD less than 80 mmHg compared to BPD >120 mmHg with an increase in treatment costs of 11.85$.

HbA_1c distribution of the patients on admission shows significant results for LOS and treatment costs. Our study concluded that LOS lowers by -2.8 days for HbA_1c levels less than 42 mmol/mol as compare to HbA_1c levels more than 48 mmol/mol, whereas the treatment cost increases by 5.86 $. Our study concluded that the patient's fasting blood sugar and random blood sugar distribution were significant in most categories except RBS: 261-290 mg/dL for LOS. Our study concluded that LOS lowers by -2.66 for FBS level 231-260 mg/dl as compare to FBS above 290 mg/dL, whereas the treatment cost of treatment increase by 3.86$.

The study reported by Fraze T *et al.* (2008) concluded in the United States, one in five hospitalizations were related to patients with diabetes totalling over 7.7 million stays and 83$ billion in hospital costs[38]. In India, approximately 73 million people living with diabetes and another 37 million with prediabetes, while nearly 47% of the diabetes cases are undiagnosed[39]. Several studies have shown that age, poor education, family history of diabetes, physical inactivity and obesity were risk factors of DM coexisting HTN[28,30,40–45].

A national audit on diabetes with co-existing hypertension is urgently needed to understand the measures needed to limit the continuously escalating costs for managing patients with DM and HTN[39]. As per our study results, only 17 % of the patients have personal health insurance cover, and only three percent of the patients have medical expenses covered by

their employers. 80 % of the patients did not have any insurance or health cover; they have to bear all treatment costs independently. Our study findings and recommendations will fill the gap in scientific knowledge, which will help Indian government decision-making and its use in policy formulation and implementation in pharmacoeconomics related areas.

5. Limitation of the study: Our study also has some limitations. Our study did not include costs related to follow-up visits, treatments after the event and further examination procedures required after discharge. The study was conducted within private hospitals rather than governmental hospitals, which might differ and limit the generalisability of the results. It was reported in the literature that private hospitals charge higher prices to make a profit as reported by Alumran Arwa et al. (2020)[40].

Abbreviations:
DM: Diabetes mellitus, HTN: Hypertension, CMS: Cost of medical supplies and equipment in $, CDT: Cost of diagnostic tests in $, CD: Cost of dialysis in $ /per session, CH: Cost of hospitalization in $, DMC: Direct medical cost in $, CT: Cost of transport in $, CSD: Cost of special diet in $, APE: Another pocket expenses in $, DNMC: Direct non-medical cost in $, INMC: Indirect non-medical cost- loss of income in $, OCT: Overall cost of the treatment in $, OCT/PD: Overall cost of the treatment per day in $, LOS: Length of stay, FBS: Fasting blood sugar in mg/dL RBS: Random blood sugar in mg/dL, BPS: Blood pressure systolic, BPD: Blood pressure diastolic, SGOT: Serum glutamic oxaloacetic transaminase, SGPT: Serum glutamic pyruvic transaminase (SGPT) level in IU/L, DCF: Data collection form, PIC: Patients' informed consent, IPD: Inpatient department., $: United State Dollar, INR: Indian Rupees, BMI: Body mass index.

References

1. Alavi N, Alami L, Taefi S, Gharabagh G. Factor analysis of self-treatment in diabetes mellitus: A cross-sectional study. BMC Public Health [Internet]. BioMed Central Ltd; 2011;11:761. Available from: http://www.biomedcentral.com/1471-2458/11/761
2. Arauz-Pacheo C, Parrott MA, Raskin P. Treatment of hypertension in adults with diabetes. Diabetes Care. 2003;26:80–2.
3. Mohan V, Seedat YK, Pradeepa R. The rising burden of diabetes and hypertension in southeast Asian and African regions: Need for effective strategies for prevention and control in primary health care settings. Int J Hypertens. 2013;2013:1–14.
4. Khatib OM, El-Guindy MS. Clinical guidelines for the management of hypertension [Internet]. World Heal. Organ. 2005. Printed by Metropole, Cairo; 2017. Available from: https://ejournal.poltektegal.ac.id/index.php/siklus/article/view/298%0Ahttp://repositorio.unan.edu.ni/2986/1/5624.pdf%0Ahttp://dx.doi.org/10.1016/j.jana.2015.10.005%0Ahttp://www.biomedcentral.com/1471-2458/12/58%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&P
5. Biswas A, Singh RK, Singh SK. Medical and non-medical cost of hypertension and heart diseases in India. Cogent Soc Sci [Internet]. Cogent; 2016;2:1–10. Available from: http://dx.doi.org/10.1080/23311886.2016.1250616
6. CDC. Epi Info 7 - User Guide [Internet]. Epi Info™ 7 User Guid. 2016. Available from: http://www.cdc.gov/epiinfo/pdfs/UserGuide/EI7Full.pdf
7. Clark V. Sample size determination. Plast Reconstr Surg. 1991;87:569–73.
8. Islam MR. Association between socio-demographic factors and blood sugar lLevels in type 2 diabetes mellitus patients in Bangladesh. J Diabetes Mellit [Internet]. 2017;07:151–9. Available from: http://www.scirp.org/journal/doi.aspx?DOI=10.4236/jdm.2017.73012
9. Ghasemi A, Zahediasl S. Normality tests for statistical analysis: A guide for non-statisticians. Int J Endocrinol Metab. 2012;10:486–9.
10. Mandal S, Maiti T, Das A, Das A, Mandal A, Sarkar B, et al. Drug utilization study in patients with type 2 diabetes mellitus attending diabetes clinic of a tertiary care hospital in rural Bengal. Int J Basic Clin Pharmacol [Internet]. 2016;5:1647–54. Available from: http://www.ijbcp.com/?mno=231772
11. Gavin JR, Alberti KGMM, Davidson MB, DeFronzo RA, Drash A, Gabbe SG, et al. Report of the expert committee on the diagnosis and classification of diabetes mellitus. Diabetes Care. 2000;23:1183–97.
12. Centers of disease control. Body mass index: Considerations for practitioners [Internet]. Dep. Heal. Hum. Serv. Centers Control Prev. 2011. p. 1–4. Available from: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Body+Mass+Index+:+Considerations+for+Practitioners#3%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Body+mass+index:+Considerations+for+practitioners#3
13. Abougalambou SSI, Mohamed M, Sulaiman SAS, Abougalambou AS, Hassali MA. Current clinical status and complications among type 2 diabetic patients in Universiti Sains Malaysia hospital. Int J Diabetes Mellit [Internet]. International Journal of Diabetes Mellitus; 2010;2:184–8. Available from: http://dx.doi.org/10.1016/j.ijdm.2010.08.001
14. Kafadar K. Testing for Normality. J Am Stat Assoc [Internet]. 2003;98:765–765. Available from: http://www.tandfonline.com/doi/abs/10.1198/jasa.2003.s285
15. Steinskog DJ, Tjøstheim DB, Kvamstø NG. A cautionary note on the use of the kolmogorov–smirnov test for normality. Mon Weather Rev [Internet]. 2007;135:1151–7. Available from: http://journals.ametsoc.org/doi/abs/10.1175/MWR3326.1
16. Kasi J, Murtuza KM, Afreen A, Rekha L. Drug utilization evaluation in diabetic patients in a tertiary care teaching hospital: a prospective observational study. J Drug Deliv Ther. 2014;4:147–51.

17. Kide S, Rangari A, Shiral R, Mane N, Yadav P, Ambulkar K, et al. Knowledge and awareness of diabetes amongst diabetes patients in Wardha region. Int J Diabetes Dev Ctries. 2014;34:232.
18. Alam MS, Aqil M, Akmal S, Qadry S, Kapur P. Utilization pattern of oral hypoglycemic agents for diabetes mellitus type 2 patients attending out-patient department at a university hospital in New Delhi. Pharmacol Pharm. 2014;2:636–45.
19. Kalk WJ, Raal FJ, Joffe BI. The prevalence and incidence of and risk factors for, micro-albuminuria among urban Africans with type 1 diabetes in South Africa: An inter-ethnic study. Int J Diabetes Mellit [Internet]. International Journal of Diabetes Mellitus; 2010;2:148–53. Available from: http://dx.doi.org/10.1016/j.ijdm.2010.10.003
20. Broberg MCG, Rose JA, Slain KN. The Relationship Between Estimated Median Household Income and Critical Care Length of Stay in Children With Diabetic Ketoacidosis. Glob Pediatr Heal. 2020;7:1–6.
21. Gajdos O, Loncak V, Barták M, Rogalewicz V. Cost of illness study of type 2 diabetes mellitus in the newly established diabetology outpatient facility in the Czech Republic. Value Heal. 2015;18:A603–4.
22. Malone M, Lau NS, White J, Novak A, Xuan W, Iliopoulos J, et al. The effect of diabetes mellitus on costs and length of stay in patients with peripheral arterial disease undergoing vascular surgery. Eur J Vasc Endovasc Surg [Internet]. Elsevier Ltd; 2014;48:447–51. Available from: http://dx.doi.org/10.1016/j.ejvs.2014.07.001
23. Eshwari K, Kamath VG, Rao CR, Kamath A. Annual cost incurred for the management of type 2 diabetes mellitus- a community-based study from coastal Karnataka. Int J Diabetes Dev Ctries. International Journal of Diabetes in Developing Countries; 2019;39:590–5.
24. Agrawal A, Gandhe M, Gandhe S, Agrawal N. Study of length of stay and average cost of treatment in Medicine Intensive care unit at tertiary care center. J Heal Res Rev. 2017;4:24.
25. Moucheraud C, Lenz C, Latkovic M, Wirtz VJ. The costs of diabetes treatment in low- and middle-income countries : a systematic review. BMJ Glob Heal. 2019;4:1–12.
26. Chen D, Liu S, Tan X, Zhao Q. Assessment of hospital length of stay and direct costs of type 2 diabetes in Hubei Province, China. BMC Health Serv Res. BMC Health Services Research; 2017;17:1–9.
27. Khanna U. The economics of dialysis in India. Indian J Nephrol. 2009;19:1–4.
28. Oberoi S, Kansra P. Economic menace of diabetes in India : a systematic review. Int J Diabetes Dev Ctries. International Journal of Diabetes in Developing Countries; 2020;1–12.
29. Grover S, Avasthi A, Bhansali A, Chakrabarti S, Kulhara P. Cost of ambulatory care of diabetes mellitus: a study from north India. Postgrad Med J. 2005;19:391–6.
30. Naser AY, Alwafi H, Alsairafi Z. Cost of hospitalisation and length of stay due to hypoglycaemia in patients with diabetes mellitus: A cross-sectional study. Pharm Pract (Granada). 2020;18:1–8.
31. Abiodun OA, Jagun OA, Olu-Abiodun OO, Sotunsa JO. Correlation between Body mass index, Waist Hip ratio, blood sugar levels and blood pressure in apparently healthy adult Nigerians. IOSR J Dent Med Sci [Internet]. 2014;13:2279–861. Available from: www.iosrjournals.org
32. Thomas G, Shishehbor M, Brill D, Nally J V. New hypertension guidelines: One size fits most? Cleve Clin J Med. 2014;81:178–88.
33. Bell K, Twiggs J, Olin BR. Hypertension : The silent killer : updated JNC-8 guideline recommendations. Alabama Pharm Assoc. 2015;3:1–8.
34. Martin J. Hypertension guidelines : Revisiting the JNC 7 recommendations. J Lancaster Gen Hosp [Internet]. 2008;3:91–7. Available from: http://www.jlgh.org/JLGH/media/Journal-LGH-Media-Library/Past Issues/Volume 3 - Issue 3/JLGH_V3n3_p91-97.pdf

35. Kadima JN, Bavhure B, Sepa JD, Murhura D. Hypertensive urgencies or emergencies and co-morbidities in Bukavu referral hospitals : clinical profile, management regimens, outcomes and drug related problems. Basic Clin Pharm. 2018;9:46–52.
36. Thygesen K, Strate M, Hansen L, Harvald B. Survival of diabetic hypertensive patients. Hypertension. 1985;7:14–7.
37. Spain L, Iser P, Steinberg A, Dwyer KM. Hypertensive crisis precipitated by insulin-induced hypoglycemia with end-stage renal failure. CKJ Clin Kidney J. 2012;5:362–3.
38. Fraze T, Jiang J, Burgess J. Hospital stays for patients with diabetes, 2008. Healthc Cost Util Proj Agency Healthc Res Qual. 2010;1–11.
39. Basu S, Sharma N. Diabetes self-care in primary health facilities in India - challenges and the way forward. World J Diabetes. 2019;10:341–9.
40. Alumran A, Almutawa H, Alzain Z, Althumairi A, Khalid N. Comparing public and private hospitals' service quality. J Public Heal. Journal of Public Health; 2020;581.
41. Chawla R, Madhu S, Makkar B, Ghosh S, Saboo B, Kalra S. RSSDI-ESI clinical practice recommendations for the management of type 2 diabetes mellitus 2020. Indian J Endocrinol Metab. 2020;24:1–122.
42. Gress TW, Nieto FJ, Shahar E, Wofford MR, Brancati FL. Hypertension and antihypertensive therapy as risk factors for type 2 diabetes mellitus. N Engl J Med. 2000;342:905–12.
43. Lancet T. Turning evidence into action on diabetes. Lancet [Internet]. Elsevier Ltd; 2020;396:1535. Available from: http://dx.doi.org/10.1016/S0140-6736(20)32412-0
44. Basu S, Garg S, Sharma N, Singh MM, Garg S, Asaria M. The determinants of out - of - pocket health - care expenses for diabetes mellitus patients in India : An examination of a tertiary care government hospital in Delhi. Perspect Clin Res |. 2020;11:86–91.
45. Care M, With P, Mellitus D. Standards of medical care for patients with diabetes mellitus. Diabetes Care. 2002;25:213–29.

Disclosers

Conflict of Interest Statement: The authors have declared that no competing interests exist.

Statement of Ethics: Informed consent was obtained from all the patients. All procedures performed in studies involving human participants followed the institutional and national research committee's ethical standards and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. IEC- ISF College of Pharmacy, Moga, Punjab approves the present study (Ref. No. ECR/296/Indt/PB/2017/ISFCP/136).

Funding Sources: There are no funding sources for this study.

Authors Contributions: AS: Collected data in ongoing study and writing the manuscript, data analysis, AB: Major contributor in writing, drafting the manuscript, DKS: Major contributor in writing and drafting the manuscript, all authors read and approved the final manuscript.

Acknowledgements: We thank the patient for allowing us to share their details and thank ISF College of Pharmacy, Moga, Punjab, and SD Thappar, Moga Hospital, Moga staff for continuous support provided.

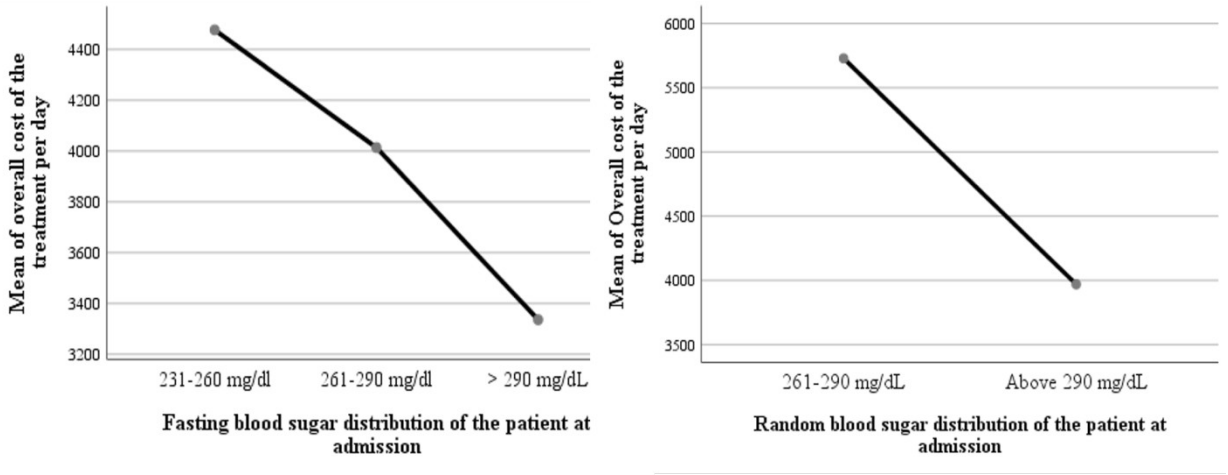

Figure 1 Comparisons of the overall cost (INR) of the treatment with FBS and RBS of the patients

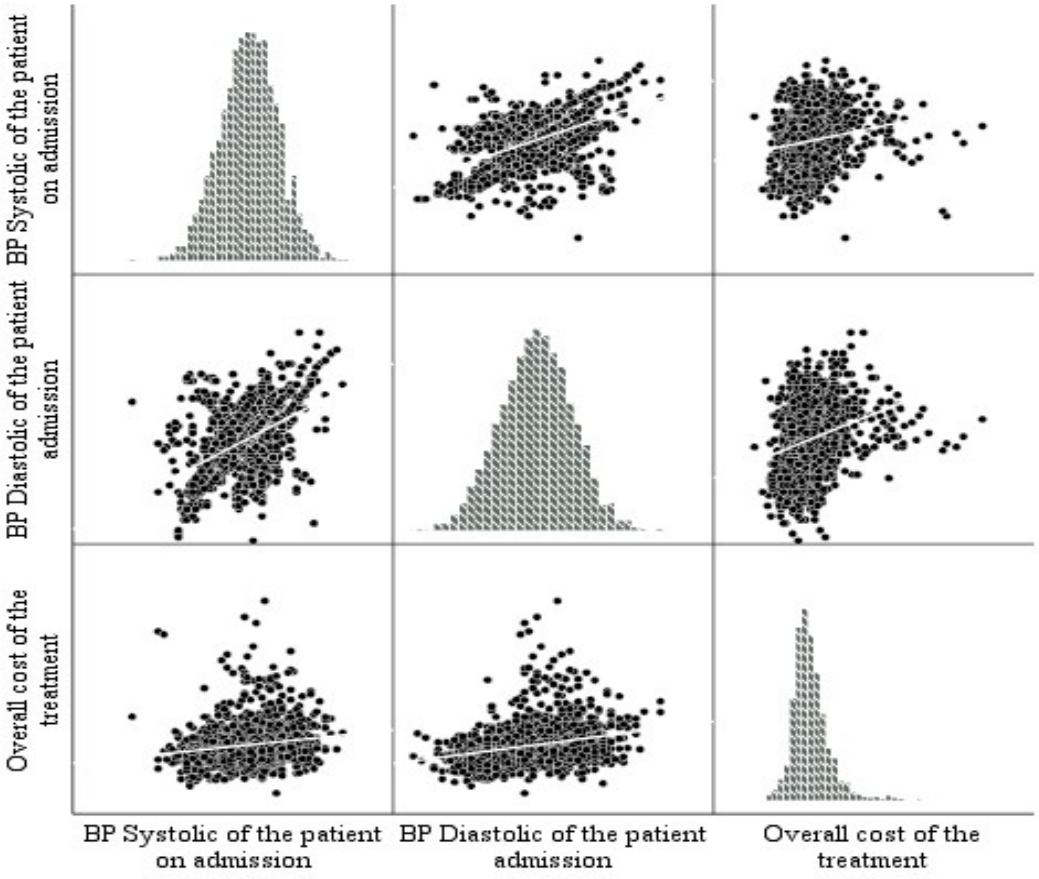

Figure 2: Scatterplot matrix BP systolic of the patient on admission, BP diastolic of the patient admission, overall cost of the treatment

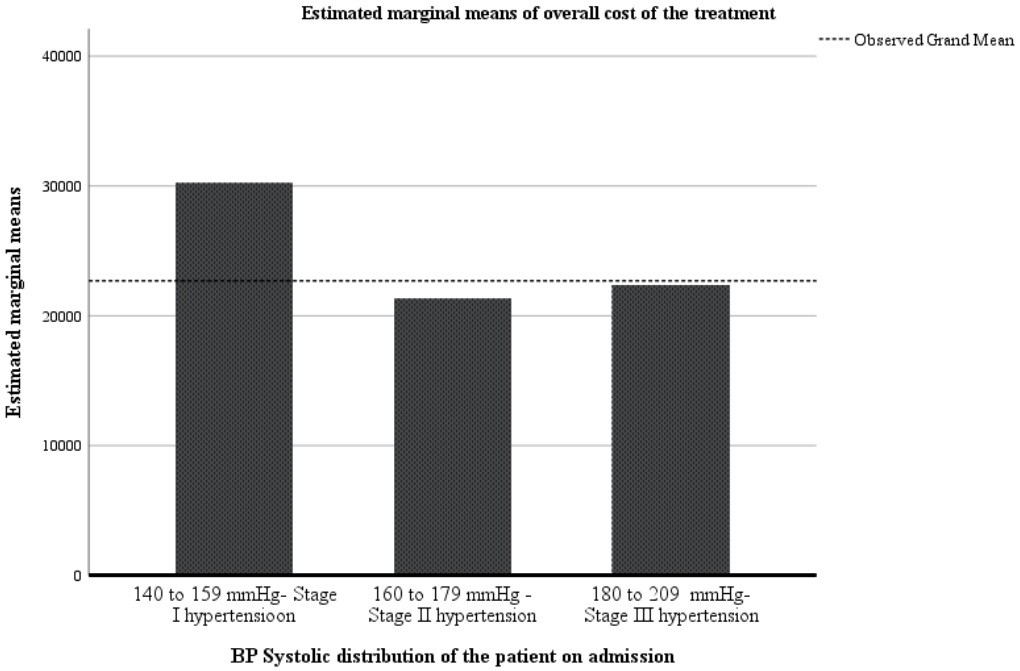

Figure 3: Estimated marginal means of the overall cost of the drug in INR with BP systolic of the patients on admission

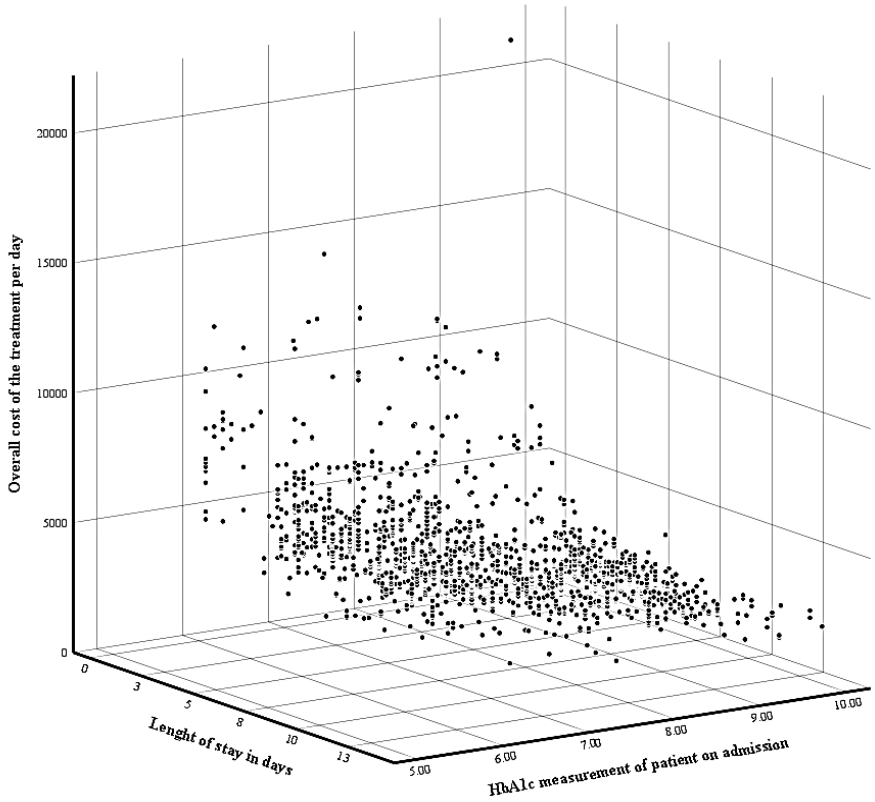

Figure 4: Simple 3-D scatter of overall cost of the treatment per day (INR) with HbA_1c of the patient during admission by the length of stay in days

Table 1 Statistics of the direct medical cost & direct non-medical cost in USD

Parameter	Direct medical cost in USD (DMC): CMS+CDT+CD+CH					Direct non-medical cost in USD (DNMC): CT+CSD+APE				INMC	Overall cost (OC): DMC+DNMC+INMC	
Type of Cost	CMS	CDT	CD	CH	DMC	CT	CSD	APE	DNMC	-	OCT	OCT/PD
Mean	21.3	14.8	47.5	131.1	186.4	6.2	18.6	14.6	39.5	82.7	308.2	54.8
Median	21.2	14.8	47.5	142.6	188.5	6.3	16.8	14.6	39.1	63.0	295.6	46.1
SD	3.9	2.6	0.1	47.0	57.0	2.4	7.7	3.5	8.8	74.3	78.4	36.6
Minimum	4.1	8.4	47.5	20.4	56.8	1.4	1.2	1.8	16.8	9.5	92.7	29.2
Maximum	32.3	22.0	47.5	285.3	386.5	14.0	44.2	26.0	65.5	719.9	952.7	603.9
Missing	0	0	0	0	0	0	0	0	0	7	0	0
N	1914	215	1914	1914	1914	1914	1914	1914	1914	1914	1914	1914

CMS: Cost of medical supplies and equipment is in USD, CDT:Cost of diagnostic tests in USD, CD: Cost of dialysisin USD /per session, CH: Cost of hospitalization in USD, DMC: Direct medical cost in USD, CT:Cost of transport in USD, CSD: Cost of special diet in USD, APE: Another pocket expenses in USD, DNMC: Direct non-medical cost inUSD, INMC: Indirect non-medicalcost- loss of income inUSD, OCT: Overall cost of the treatmentin USD, OCT/PD:Overall cost of the treatment per day inUSD

***Table 2 Codes and value label used in GML for FBS, RBS,* HbA1c, BPS, BPD on admission**

Particular	SPSS Code	Value Label	N
Fasting blood sugar distribution of the patient at admission	4	231-260 mg/dl	293
	5	261-290 mg/dl	1480
	6	> 290 mg/dL	141
Random blood sugar distribution of the patient at admission	5	261-290 mg/dL	71
	6	Above 290 mg/dL	1843
HbA_1c distribution of the patients on admission	1	Normal: Below 42 mmol/mol (6.0%)	40
	2	Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	111
	3	Diabetes: 48 mmol/mol (6.5% or over)	1763
BP Systolic distribution of the patient on admission	3	140 to 159 mmHg- Stage I hypertension	1
	4	160 to 179 mmHg - Stage II hypertension	125
	5	180 to209 and above mmHg- Stage III hypertension	1787
BP Diastolic distribution of the patient on admission	0	< 80 mmHg - Normal	17
	1	80 - 84 mmHg - Prehypertension	57
	2	85 - 89 mmHg - Prehypertension	144
	3	90 - 99 mmHg - Stage I hypertension	654
	4	100 - 109 mmHg- Stage II hypertension	755
	5	110- 119 mmHg- Stage III hypertension	261
	6	>120 mmHg- Hypertensive crisis	25

Table 3 Descriptive Statistics: GLM: BP systolic & BP diastolic of the patient on admission with the length of stay in days and overall cost of the treatment per day

Variable	BP Systolic on admission	BP Diastolic on admission	Length of stay in days			Overall costof thttreatment per day		
			Mean	SD	N	Mean	SD	N
Length of stay in days & overall cost of treatment per day	140 to 159 mmHg- Stage I hypertension	110- 119 mmHg- Stage III hypertension	14.00	.	1	31.19	-	1
	160 to 179 mmHg - Stage II hypertension	< 80 mmHg - Normal	4.15	1.51	13	72.39	20.75	13
		80 - 84 mmHg - Prehypertension	3.78	1.34	23	71.15	26.79	23
		85 - 89 mmHg - Prehypertension	4.80	1.86	41	58.47	19.34	41
		90 - 99 mmHg - Stage I hypertension	4.95	2.78	22	100.21	104.84	22
		100 - 109 mmHg- Stage II hypertension	4.91	1.70	11	66.71	21.79	11
		110- 119 mmHg- Stage III hypertension	4.53	1.68	15	61.49	14.29	15
	180 to 209 mmHg- Stage III hypertension	< 80 mmHg - Normal	3.50	2.38	4	74.08	34.69	4
		80 - 84 mmHg - Prehypertension	5.44	1.84	34	53.87	13.04	34
		85 - 89 mmHg - Prehypertension	5.51	1.95	103	54.67	17.26	103
		90 - 99 mmHg - Stage I hypertension	6.17	2.03	632	53.18	28.29	632
		100 - 109 mmHg- Stage II hypertension	6.71	2.15	744	54.99	37.33	744
		110- 119 mmHg- Stage III hypertension	7.51	2.64	245	53.01	52.01	245
		>120 mmHg- Hypertensive crisis	9.04	2.96	25	43.92	11.81	25
	Total	< 80 mmHg - Normal	4.00	1.69	17	72.79	23.43	17
		80 - 84 mmHg - Prehypertension	4.77	1.84	57	60.84	21.34	57
		85 - 89 mmHg - Prehypertension	5.31	1.94	144	55.75	17.89	144
		90 - 99 mmHg - Stage I hypertension	6.13	2.07	654	54.76	34.63	654
		100 - 109 mmHg- Stage II hypertension	6.68	2.16	755	55.16	37.17	755
		110- 119 mmHg- Stage III hypertension	7.37	2.71	261	53.41	50.55	261
		>120 mmHg- Hypertensive crisis	9.04	2.96	25	43.92	11.81	25
		Total	6.43	2.30	1913	55.01	36.76	1913

***Table 4 Descriptive statistics: FBS at admission, RBS at admission, and HbA1c on admission with the length of stay in days &* overall cost of the treatment per day**

Variable	FBS at admission	RBS at admission	HbA1c on admission	Length of stay in days			Overall cost of thetreatment per day		
				Mean	SD	N	Mean	SD	N
Length of stay in days & Overall cost of the treatment per day	231-260 mg/dl	261-290 mg/dL	Normal: Below 42 mmol/mol (6.0%)	2.00	0.01	13	152.53	114.38	13
			Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	4.28	1.46	36	66.59	16.20	36
			Diabetes: 48 mmol/mol (6.5% or over)	5.23	1.87	22	52.96	9.47	22
		Above 290 mg/dL	Normal: Below 42 mmol/mol (6.0%)	3.71	2.36	7	95.75	35.35	7
			Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	3.97	1.61	33	71.07	23.95	33
			Diabetes: 48 mmol/mol (6.5% or over)	5.86	1.97	182	51.22	15.78	182
		Total	Normal: Below 42 mmol/mol (6.0%)	2.60	1.56	20	132.66	97.10	20
			Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	4.13	1.53	69	68.74	20.25	69
			Diabetes: 48 mmol/mol (6.5% or over)	5.79	1.96	204	51.41	15.22	204
	261-290 mg/dl	Above 290 mg/dL	Normal: Below 42 mmol/mol (6.0%)	4.05	2.39	20	98.53	45.48	20
			Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	4.26	1.82	42	76.95	28.38	42
			Diabetes: 48 mmol/mol (6.5% or over)	6.58	2.08	1418	53.44	37.62	1418
	> 290 mg/dL	Above 290 mg/dL	Diabetes: 48 mmol/mol (6.5% or over)	8.55	2.78	141	45.48	17.12	141
	Total	261-290 mg/dL	Normal: Below 42 mmol/mol (6.0%)	2.00	0.01	13	152.53	114.38	13
			Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	4.28	1.46	36	66.59	16.20	36
			Diabetes: 48 mmol/mol (6.5% or over)	5.23	1.87	22	52.96	9.47	22
		Above 290 mg/dL	Normal: Below 42 mmol/mol (6.0%)	3.96	2.34	27	97.81	42.44	27
			Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	4.13	1.72	75	74.36	26.52	75
			Diabetes: 48 mmol/mol (6.5% or over)	6.66	2.21	1741	52.57	34.74	1741
		Total	Normal: Below 42 mmol/mol (6.0%)	3.33	2.12	40	115.59	76.81	40
			Prediabetes: 42 to 47 mmol/mol (6.0 to 6.4%)	4.18	1.64	111	71.84	23.87	111
			Diabetes: 48 mmol/mol (6.5% or over)	6.64	2.22	1763	52.57	34.54	1763
			Total	6.43	2.30	1914	55.00	36.75	1914

Table 5 Parameter estimates: Length of stay in days & overall cost of the treatment per day

Dependent Variable	Parameter	B	Std. Error	*t*	*Sig.*	B	Std. Error	*t*	*Sig.*
	Blood pressure category	Length of stay in days				Overall cost of the treatment per day			
Length of stay in days & Overall cost of the treatment per day	Intercept	9.04	.43	20.76	*.001*	43.92	7.31	6.00	*.001*
	[BPSACAT=140 to 159 mmHg]	6.57	2.18	3.01	*.003*	-21.31	36.63	-.58	*.561*
	[BPSACAT=160 to 179 mmHg]	-1.39	.22	-6.16	*.001*	17.22	3.80	4.52	*.001*
	[BPSACAT=180 to>209mmHg]	0[a]	.	.	.	0[a]	.	.	.
	[BPDACAT=< 80 mmHg]	-3.97	.70	-5.62	*.001*	15.69	11.85	1.32	*.18*
	[BPDACAT=80 - 84 mmHg	-3.70	.53	-6.98	*.001*	9.97	8.90	1.12	*.26*
	[BPDACAT=85 - 89 mmHg]	-3.33	.47	-6.99	*.001*	6.93	7.99	.86	*.03*
	[BPDACAT=90 - 99 mmHg]	-2.86	.44	-6.46	*.001*	10.26	7.45	1.37	*.01*
	[BPDACAT=100 - 109 mmHg]	-2.33	.44	-5.28	*.001*	10.99	7.43	1.47	*.02*
	[BPDACAT=110 - 119 mmHg]	-1.61	.45	-3.54	*.001*	8.58	7.66	1.12	*.02*
	[BPDACAT=>120 mmHg]	0[a]	.	.	.	0[a]	.	.	.
	Blood glucose category	Length of stay in days				Overall cost of the treatment per day			
Length of stay in days & Overall cost of the treatment per day	Intercept	8.54	.17	48.11	*.001*	45.48	2.98	15.27	*.0*
	[FBSACAT=231-260 mg/dl]	-2.66	.23	-11.57	*.001*	5.53	3.86	1.43	*.152*
	[FBSACAT=261-290 mg/dl]	-1.97	.18	-10.62	*.001*	7.91	3.12	2.53	*.011*
	[FBSACAT=> 290 mg/dL]	0[a]	.	.	.	0[a]	.	.	.
	[RBSACAT=261-290 mg/dL]	-.25	.30	-.84	*.397*	6.93	5.13	1.35	*.177*
	[RBSACAT= Above 290 mg/dL]	0[a]	.	.	.	0[a]	.	.	.
	[HbA_1c=< 42 mmol/mol]	-2.8	.35	-8.05	*.001*	61.14	5.86	10.42	*.001*
	[HbA_1c=42 to 47 mmol/mol]	-1.87	.22	-8.19	*.001*	17.68	3.84	4.60	*.001*
	[HbA_1c=> 48 mmol/mol]	0[a]	.	.	.	0[a]	.	.	.

Table 6 Multivariate tests[a]: Dependent variable: **Length of stay in days & overall cost of the treatment per day**

Effect		Value	*F*	Hypothesis *df*	Error *df*	*Sig.*
BPSACAT	Pillai's Trace	0.02	12.60	4.0	3808.0	*.001*
	Wilks' Lambda	0.97	12.66[b]	4.0	3806.0	*.001*
	Hotelling's Trace	0.02	12.72	4.0	3804.0	*.001*
	Roy's Largest Root	0.02	24.01[c]	2.0	1904.0	*.001*
BPDACAT	Pillai's Trace	0.08	14.45	12.0	3808.0	*.001*
	Wilks' Lambda	0.91	14.76[b]	12.0	3806.0	*.001*
	Hotelling's Trace	0.09	15.06	12.0	3804.0	*.001*
	Roy's Largest Root	0.09	29.51[c]	6.0	1904.0	*.001*
FBSACAT	Pillai's Trace	.081	40.4	4.0	3816.0	*.001*
	Wilks' Lambda	.919	41.2[b]	4.0	3814.0	*.001*
	Hotelling's Trace	.088	42.0	4.0	3812.0	*.001*
	Roy's Largest Root	.086	82.3[c]	2.0	1908.0	*.001*
RBSACAT	Pillai's Trace	.001	.93[b]	2.0	1907.0	*.027*
	Wilks' Lambda	.999	.93[b]	2.0	1907.0	*.027*
	Hotelling's Trace	.001	.93[b]	2.0	1907.0	*.027*
	Roy's Largest Root	.001	.93[b]	2.0	1907.0	*.027*
HbA_1cAddC	Pillai's Trace	.084	41.59	4.0	3816.0	.001
	Wilks' Lambda	.917	42.08b	4.0	3814.0	.001
	Hotelling's Trace	.089	42.57	4.0	3812.0	.001
	Roy's Largest Root	.078	74.61c	2.0	1908.0	.001

a. Design: Intercept + BPSACAT + BPDACAT+BSACAT+RBSACAT+HbA1cAddC

b. Exact statistic

c The statistic is an upper bound on F that yields a lower bound on the significance level.

BPSACAT: Blood pressure systolic on admission, BPDACAT: Blood pressure diastolic on admission, FBSACAT: Fasting blood suger on admission, RBSACAT: Random blood suger on admission, HbA_1cAddC: HbA_1c on admission

Table 7 Test between subject: Dependent variable: **Length of stay in days & overall cost of the treatment per day**

Source	Dependent Variable	Type III Sum of Squares	*df*	Mean Square	F	*Sig.*
BPSACAT	Length of stay in days	224.3	2	112.16	23.67	*.001*
	Overall cost of the treatment per day	150022127.722	2	75011063.86	10.43	*.001*
BPDACAT	Length of stay in days	640.4	6	106.74	22.53	*.001*
	Overall cost of the treatment per day	30602671.2	6	5100445.20	0.70	*.021*
FBSACAT	Length of stay in days	636.6	2	318.3	71.5	.001
	Overall cost of the treatment per day	46285464.9	2	23142732.4	3.4	.030
RBSACAT	Length of stay in days	3.1	1	3.1	0.7	.029
	Overall cost of the treatment per day	12283707.5	1	12283707.5	1.8	.027
HbA_1cAddC	Length of stay in days	513.1	2	256.5	57.6	.001
	Overall cost of the treatment per day	797070322.4	2	398535161.2	59.2	.001

BPSACAT: Blood pressure systolic on admission, BPDACAT: Blood pressure diastolic on admission, FBSACAT: Fasting blood suger on admission, RBSACAT: Random blood suger on admission, HbA_1cAddC: HbA_1c on admission