International Journal of Health Sciences and Research
Vol.10; Issue: 4; April 2020
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

A Study on Cost Analysis in Diabetic Patients with Cardiovascular Complications in a Tertiary Care Teaching Hospital

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ABSTRACT

Diabetes Mellitus (DM) is a chronic disease and is termed as pandemic in 21st century as its prevalence is rising across the countries. The objectives of this study include assessing the economic burden in Diabetic patients with cardiovascular complications to evaluate the average investigation and medication cost for T2DM with cardiovascular complications to evaluate the average total cost (direct and indirect cost) for T2DM and T2DM with cardiovascular complications and to assess the impact of non-pharmacological approaches in the reduction of economic burden. The data was collected from case files of patients with T2DM and cardiovascular complications which consisted of laboratory investigation reports, treatment charts and interviewing patients or care takers. The commonly occurring cardiovascular complication was found to be Hypertension which constitutes about 46.6% of total patients. The impact of non-pharmacological approach was assessed by comparing the total drug cost. It was found out that patient who followed exercise, diet and DASH had least cost of medication per person i.e. ₹ 1938.6. Laboratory cost is the major contributing factor towards the diagnosis cost of a Hypertensive patient. The direct medical cost for patients with Diabetes Mellitus is ₹ 11957.2. The direct medical cost is the highest in patients with Stroke as complication i.e. ₹ 73827. The contributory factor is surgical cost. Productivity loss was calculated to check the indirect cost. The average productivity loss was found to be ₹ 91692.7881. From the current data it was found that cardiovascular complications increase the economic burden among patients with T2DM.

Keywords: Direct cost, Indirect cost, Productivity loss, Diabetes Mellitus, Cardio vascular complications, Economic burden.

1.0 INTRODUCTION

1.1 PHARMACOECONOMICS

Pharmacoeconomics is the scientific discipline that assesses the clinical, monetary and humanistic parts of pharmaceutical items, administrations, and projects, just as other social insurance mediations to give medicinal services chiefs, suppliers and patients with important data for ideal results and the designation of social insurance assets. Pharmacoeconomics techniques provides valuable information to health care decision makers for the allocation of scarce resources.[1]

Economic evaluation is one part of health economics, and it is a tool for comparing costs and consequences of different interventions. The cost analysis involves the estimation of Direct (Medical and non-medical) and Indirect costs of the condition. Direct clinical expenses involves the expenses identifying with administrations given by emergency clinic, including inpatient stays, ICU stays,

research center tests and other emergency clinic visits; authority and essential consideration specialist visits, community health laborer, nurse, health instructor, drug specialist and prescription. Direct non-clinical expenses contain cost of movement for treatment to and from medical clinics, nourishment cost and paid caregivers. The indirect expenses contain opportunity cost of time lost because of grimness and incorporate efficiency misfortunes by patients and by family members or parental figures going with patients.[2]

1.2 DIABETES MELLITUS

1.2.1 DEFINITION AND CLASSIFICATION

In the 21st century, Diabetes is termed as 'pandemic', as its prevalence is rising across the countries and it has been granted the status of 'public health priority' in most of the nations**.**[3]

Diabetes Mellitus (DM) is characterized as a chronic disease that occurs when the pancreas does not produce enough insulin or is insulin deficient, or when the body is unable to use the generated insulin effectively.

The major two clinical classes of T2DM are childhood Diabetes Mellitus, Insulin dependent Diabetes Mellitus (or Type 1 Diabetes Mellitus) and adulthood Diabetes Mellitus, non-Insulin dependent Diabetes Mellitus (or T2DM). T2DM accounts more than 90% of all Diabetic patients.

Type 1 Diabetes Mellitus

Type 1 Diabetes is characterized by insulin output deficiency, which involves routine insulin administration. The cause of type 1 diabetes is unclear, even despite current knowledge, it is not preventable. The signs include excessive urinary excretion (polyuria), fatigue (polydipsia), persistent hunger, weight loss, changes in vision and tiredness.

Type 2 Diabetes Mellitus

T2DM results from insulin being used ineffectively by the body. T2DM affects most people with diabetes globally, and is largely the result of excess body weight and physical inactivity. Symptoms may be similar to those of Type 1 Diabetes, but often are less pronounced. As a result, several years after the onset, once symptoms have already occurred, the disease can be diagnosed.[4-5]

1.2.2 GLOBAL EPIDEMIOLOGY OF DIABETES

Due to aging, increased population growth, urbanization and high prevalence of obesity and inactive lifestyle, the number of diabetes is steadily increasing globally.4 WHO projected global living with diabetes was estimated at 422 million adults in 2014 compared to 108 million in 1980. The global (age-standardized) prevalence of Diabetes has almost doubled since 1980, rising from 4.7 percent to 8.5 percent in the adult population. In low- and middle-income countries, the incidence of diabetes has increased faster than in high-income countries in the past decade. By 2012, diabetes had caused 1.5 million deaths. Higher-than-optimal blood glucose caused 2.2 million extra deaths, increasing the risk of cardiovascular and other diseases. Before the age of 70, 43% of these 3.7 million deaths occur. In low- and middle-income countries, the percentage of deaths due to high blood glucose or diabetes that occur before age 70 is higher than in high-income countries[6].

A study done by Amy Bradshaw Kaiser *et. al.*, estimates that in 2018 there are more than 500 million people have T2DM.[7] People with Diabetes comprise 8.8% of the world's population, and International Diabetes Federation (IDF) predicts that the number of cases of Diabetes will rise to 642 million by 2040.[8]

1.2.3 DIABETES IN INDIA

India leads the world with largest number of Diabetic subjects earning the dubious distinction of being termed the "Diabetes capital of the world".[9]

Diabetes epidemiology has a long tradition in India. The first national study recorded an average prevalence of 2.1% in urban areas and 1.5% in rural areas. It is evident from the available region-based

population-based studies that there has been a marked increase in the prevalence of diabetes among both urban and rural Indians over the past two decades, with the sharpest rise in Southern India.

With 69.2 million people with diabetes and another 36.5 million with prediabetes, which is a high-risk condition for diabetes and cardiovascular disease, India ranks second among the top 10 countries in the world.[10]

1.3 DIABETES AND CARDIOVASCULAR COMPLICATIONS

A major co-morbidity of diabetes is Cardiovascular disease (CVD), which affects about one-third of population with Diabetes and is one of the major cause of mortality among people with DM and Coronary Heart Disease (CHD) are the most common cause of death among people with T2DM.[11,20] It is estimated that up to 80 percent of the 200 million people suffering from T2DM die from CVD annually globally. The T2DM pandemic has emerged as a major and rising health issue in recent years. The complications of cardiovascular (CV) associated with T2DM cause a considerable amount of disability, premature mortality, productivity loss and a tremendous increase in the burden on health care systems and economies worldwide. Thus CVD and T2DM have become inseparable, and the global health policies need to tackle this.[12]

1.4 COST OF DM

In India, 85-95% of all healthcare costs come from household income for individuals and their families. Direct spending consumes 27–34% of rural and urban poor household income, while rural and urban middle-to-high income groups consume 5.0–12.6% and Diabetes treatment 4.8–16.9 % of income, respectively.[13]

According to WHO and the UN Human Settlements Programme for India, the economic implications of cardiovascular diseases during the period is pegged at $2.25 trillion, the same as that of Diabetes.[14] The annual spend on account of Diabetes treatment in India is marked at ₹1.5 lakh crore which is 4.7 times the centre's allocation 32,000 crore and the presence of CVD with Diabetes corresponds to this amount. Increased availability of refined foods and limited physical activity were recognized as the main causes of the burden on Diabetes and the related cardiovascular complications apparently.[15]

The high cost of managing Diabetes patients is contributed substantially by cardiovascular complications and adds up to the growing challenges for the health care system. There has been increased focus on the joint management of CVD and T2DM due to the substantial clinical and economic burden of CVD among patients with T2DM. Current management approaches involve setting targets for glycated haemoglobin (HbA1c), lipids, and blood pressure.[10, 16]

Since most people are not covered by health insurance, in India health costs are paid out of pocket, and the cost of treatment can have major financial implications. In the event of complications or when insulin therapy is required or hospital admission or surgery is required, the cost of Diabetes care is observed to increase multiples. In Asian Indians, inadequate funding and medical reimbursement, insufficient healthcare budget, and socioeconomic barriers lead to the increasing cost of managing diabetes and CVDs.[17, 18]

4.0 METHODOLOGY

4.1 MATERIALS AND METHODS

4.1.1 Study Site

Srinivas Institute of Medical Sciences and Research Centre, Mukka, Mangaluru. India.

4.1.2 Study Design

It is a Prospective observational study

4.1.3 Sample Size

A total of 150 patients were included according to inclusion and exclusion criteria.

4.1.4 Study Duration

Study was conducted for duration of 6 months. (September 2018 to March 2019)

4.1.5 Ethical Approval

Ethical clearance was obtained from the Institutional Ethics Committee (IEC),

Srinivas Institute of Medical Sciences and Research Centre, Mukka, Mangaluru, India

4.1.6 Study Subjects

Patients diagnosed with T2DM accompanying CV complications from Srinivas Institute of Medical Sciences and Research Centre, Mukka, Mangaluru, India

4.1.7 Study Criteria

Inclusion criteria:

- Patients of either gender with more than 35 years age having T2DM
- Patients who are diagnosed with T2DM and T2DM along with its CV complications (HTN, Atherosclerosis, CHD, HF, Angina, MI and stroke) during the study period
- Patients who are willing to participate in the study

Exclusion criteria

- Patients aged below 35 years and having T2DM
- Patients with Diabetes and other complications
- Patients without T2DM, with CVD
- Vulnerable populations without geriatrics
- Patients who did not agree to participate in the study

4.1.8 Sources of data collection

The data was collected from case files of patients with T2DM and CV complications which consisted of laboratory investigation reports, treatment charts and interviewing patients or patient care takers. A total of 150 validated Data Collection Form was filled accordingly.

4.1.9 Materials used:

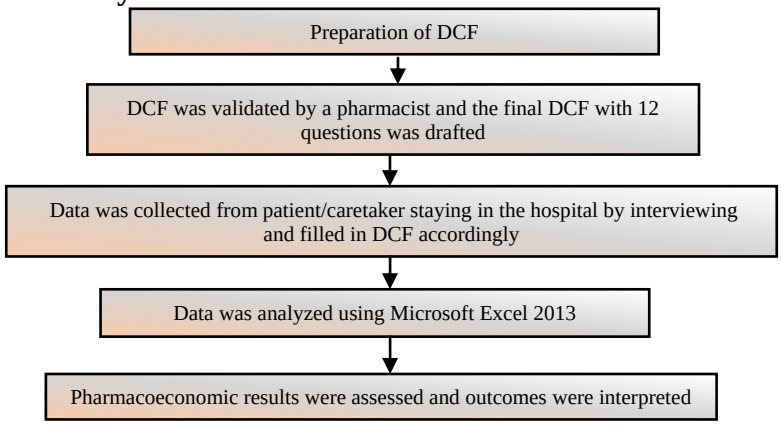
In order to record all the necessary data, a Data Collection Form (DCF) was designed based on the details needed for the study and was validated by the health care professionals. This included the following:

- Demography of patient including age, sex, social history, lifestyle modification
- Level of education, occupation, income of both patient as well as caretaker
- Health related costs such as laboratory, medication, consultation, hospitalization and surgical costs
- Other costs

4.1.10 Study method

The study was carried out as per the protocol approved by IEC. Based on the study criteria, procedures were explained and an informed consent form was obtained from the patients. A Validated DCF was filled accordingly while interviewing the patient or caretaker. The interview was carried out in English, Kannada and Malayalam languages for convenience and understanding of respondents. Details were filled in an English printed DCF. 150 patients of either gender who had T2DM with/without CV complications were participated in the interrogation. Health related costs, hospital associated costs and other expenses such as transportation cost and food cost were enquired correspondingly. The discussion was only done in accordance with the patient/caretaker, during their stay in hospital. The data collected thereafter was kept confidential.

4.1.11 Operation Modality



5.0 STATISTICAL ANALYSIS

M S Excel 2013 was used for pharmacoeconomic analysis.

6.0 RESULTS

6.1 CHARACTERISTICS OF STUDY POPULATION

A total of 150 patients with T2DM were participated in our study. Majorities (62%) of study subjects were male and 38% were females and 62.7% of participants belonged to the rural area. The highest percentage of age group was more than 61 years (38%) followed by 70 years and above (36%), age group of 51-60 years (16%), 41-50 years (7.3%) and 31-40 years (2.7%) (Figure 1). Among the subjects, majority (59.3%) had school level education, 26.7% were graduated, 6.7% had a professional qualification and 7.3% were illiterates. By occupation a total of 62% were employed, 26% of individuals were self-employed, and 24% were retired, 14.7% were non-workers and 6% of patients were house-wives (Figure 2). Family history of participants was recorded. The percentage of family history with DM was 27%, DM with HTN was 3.3% and 70% were having no significant family history (Figure 3). The socio-demographic profile of study participants were given in Table 1.

Table 1- Socio-demographic profile of study participants

Variables	Number	Percentage (%)
Gender		
Male	93	62%
Female	57	38%
Age		
31-40 years	4	2.7%
41-50 years	11	7.3%
51-60 years	24	16%
61-70 years	57	38%
>71 years	54	36%
Occupation		
Non-worker	22	14.7%
Self-employed	11	7.3%
Employed	39	26%
Agriculturist	9	6%
Labourer	26	17.3%
Retired	36	24%
House wife	7	4.7%
Social history		
Smoking	3	2%
Alcohol	4	2.7%
Smoking and alcohol	3	2%
Nil	140	93.3%
Family history		
DM	40	26.7%
DM and HTN	5	3.3%
Not significant	105	70%

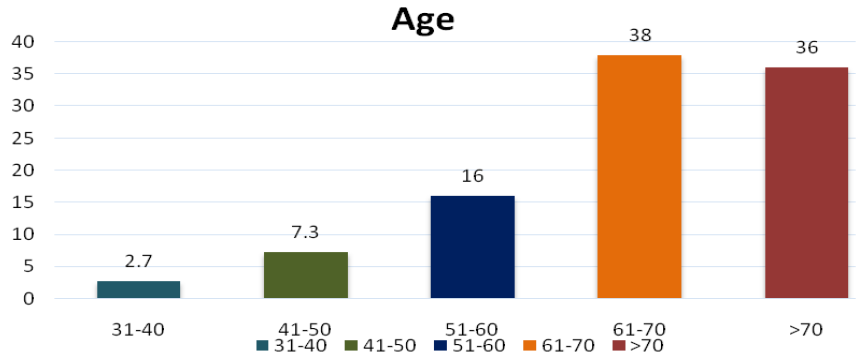


Figure 1: Distribution of different age group.

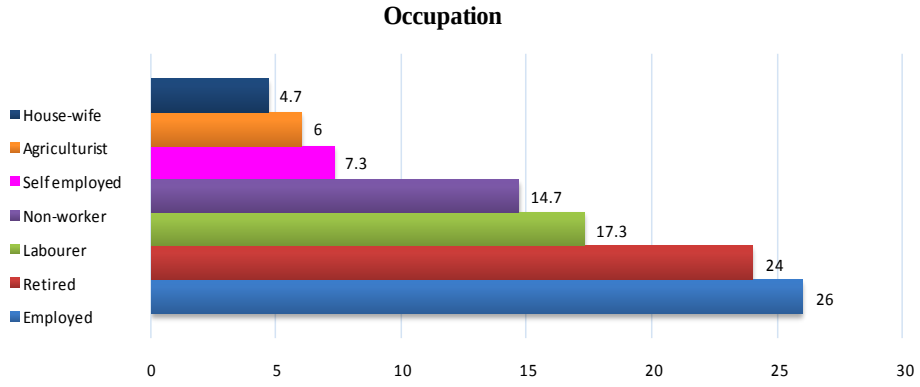


Figure 2- Occupational denomination in the study subjects

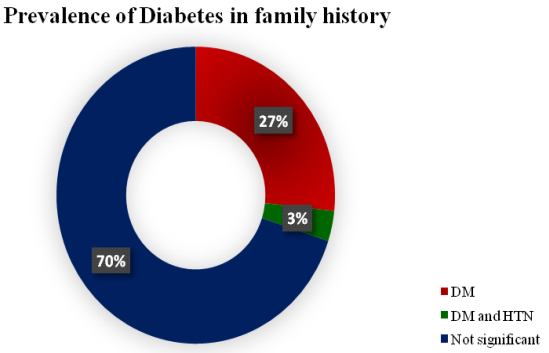


Figure 3- Family history of diabetes

6.2 EVALUATION OF DRUG UTILIZATION PATTERN

Drug-prescribing pattern research gives insight into developments in the use of Diabetes medications and the treatment of their co-morbid conditions. Prescription pattern awareness can contribute to the use of appropriate drugs and help to take measures to improve prescribing habits.

6.2.1 Anti-Diabetic Agents

Almost 41.3% of patients were exclusively treated with Neutral Insulin as Insulin therapy and 15.3% used Isophane Insulin followed by 0.6% of Insulin Aspart and 0.6% of Insulin Degludec. Metformin was used as monotherapy by 18% of patients from Biguanides class of drugs. Glimepiride and Gliclazide were received by 8% and 6% of patients respectively from Sulfonylureas category. The rest of the hypoglycemic agents consumed by the patients are tabulated in Table 2.

Table 2- Drug utilization of hypoglycemic agents

Anti-Diabetic Classification	Drugs
Biguanides	Metformin: 27 (18%)
Sulfonylureas	Glimepiride: 12 (8%) Gliclazide: 9 (6%) Glibenclamide: 1 (0.6%)
Meglitinides	Repaglinide: 1 (0.6%)
Dipeptyl peptidase IV inhibitors (Gliptins)	Teneleglitin: 3 (2%), Linagliptin: 2 (1.3%), Vildagliptin: 2 (1.3%)
Combination regimen Biguanide and Sulfonylurea Gliptin and Biguanide	Glimepiride + Metformin: 17 (11.3%) Teneleglitin/Vildagliptin/Sitagliptin+Metformin: 7 (4.6%) Glicazide + Metformin: 1 (0.6%) Glimepiride + Metformin + Pioglitazone: 1 (0.6%)
Insulin Therapy	Neutral Insulin: 62 (41.3%) Isophane Insulin: 23 (15.3%) Insulin Aspart: 1 (0.6%) Insulin Degludec: 1 (0.6%)

6.2.2 Cardiovascular Drugs

Table 3- Drug utilization of cardiovascular agents

Type of cardiovascular complication	Classification
Hypertension **(Anti-Hypertensive)**	ACEI- Ramipril: 4 (2.6%), Enalapril: 1 (0.6%), AT1 antagonists- Telmisartan: 19 (12.6%) Losartan: 5 (3.3%) CCB- Amlodipine: 27 (18%), Nifedipine: 8 (5.3%), Cilnidipine: 4 (2.6%) Diuretics- Torsemide: 12 (8%), Furosemide: 6 (4%), Mannitol: 2 (1.3%) α -adrenergic blockers- Prazosin: 5 (3.3%) β + α adrenergic blocker- Carvedilol: 5 (3.3%)
Angina **(Anti-Anginals)**	Nitrates- a) Short acting- Nitroglycerine: 1 (0.6%) b) Long acting- ISMN: 4 (2.6%), ISDN: 1 (0.6%) β blockers- Metoprolol: 11 (7.3%), Bisprolol/Labetolol/Propanolol: 2 (1.3%), Atenolol: 1 (0.6%)
IHD and Stroke	Central sympatholytic- Clonidine: 9 (6%). Vasodilators- Spironolactone: 3 (2%), Amiloride: 1 (0.6%), Hydralazine: 1 (0.6%) Anti-thrombotics- Aspirin: 13 (8.6%), Clopidogrel: 5 (3.3%). Anticoagulant- Heparin: 2 (1.3%).
Atherosclerosis	Statins- Atorvastatin: 14 (9.3%), Rosuvastatin: 2 (1.3%).
Type of Combination regimen	**Medications**
Dual Therapy	Aspirin + Atorvastatin: 20 (13.3%) Hydrochlorthiazide + Losartan/Telmisartan: 2 (1.3%) Furosemide/Torsemide + Spironolactone/Amiloride: 6 (4%) Atorvastatin + Clopidogrel: 2 (1.3%) Ramipril + Hydrochlorthiazide: 1 (0.6%) Clopidogrel + Aspirin: 1 (0.6%) Rosuvastatin + Fenofibrate: 1 (0.6%) Trimetazidine + Dihydrochloride: 1 (0.6%)
Triple therapy	Aspirin + Clopidogrel + Atorvastatin: 11 (7.3%)

The anti-hypertensive agent Amlodipine was prescribed to 27 (18%) patients and was the most consumed cardiovascular agent. Among the study subjects second most used drug was Telmisartan which was given to 19 (12.6%) patients and Torsemide as diuretic was used by 8% of patients. The details of prescribed cardiovascular agents are shown in Table 3.

6.3 OTHER DRUGS GIVEN FOR THE COMORBID CONDITIONS

Diabetic patients who are admitted to the hospital were having various related comorbidities and thus to subside the condition, variable symptomatic treatment modalities were implemented which added up to the treatment cost for the patients. These comorbid conditions were just symptoms and was not diagnosed as disease i.e. Respiratory difficulty was just a condition and not diagnosed as Asthma or COPD and thus following the inclusion criteria. A brief description of the other drugs used is shown in Table 4.

Table 4- Drug utilization of other agents

Respiratory comorbidities	**Drugs**
B_2 Sympathomimetics	Salbutamol: 5 (3.3%)
Methylxanthines	Theophylline: 5 (3.3%) Deriphylline: 1 (0.6%) Doxophylline: 1 (0.6%)
Anti-cholinergics	Ipratropium Bromide: 1 (0.6%)
Corticosteroids	Budesonide: 6 (4%) Dexamethasone: 4 (2.6%) Hydrocortisone: 2 (1.3%) Fluticasone: 2 (0.6%)
Dual therapy	Ipratropium bromide + Budesonide: 6 (4%) Etophylline + Theophylline: 3 (2%) Albuterol + Ipratropium bromide: 3 (2%) Levocetrizine + Montelukast: 1 (0.6%) Doxophylline + Montelukast: 1 (0.6%)
Analgesics Narcotics	**Drugs** Tramadol: 12 (8%) Acetaminophen: 32 (21.3%)
NSAIDS	Mefenamic acid: 2 (1.3%) Naproxen: 1 (0.6%) Diclofenac: 1 (0.6%)
Opioids	Butorphanol: 3 (2%)
Dual therapy	Tramadol + Paracetamol: 16 (10.6%)
Triple therapy	Tramadol + Paracetamol + Domperidone: 3 (2%)
Cholinergics	**Anti-histamines**
Carbamates- Donepezil (0.6%)	Pheniramine: 2 (1.6%)
Anti-Anxiety	**Drugs**
Benzodiazepines	Lorazepam: 3 (2%) Midazolam: 2 (1.3%) Nitrozepam: 1 (0.6%)
Sedative Antihistamine	Hydroxyzine: 1 (0.6%)
Atypical anti-depressants	Mirtazapine: 2 (1.3%) Duloxetine: 1 (0.6%)
Tricyclic anti-depressants	Dosulepin: 1 (0.6%) Amitriptylline: 1 (0.6%)
Atypical Anti-psychotic	Quetiapine: 3 (2%)
Dual therapy	Fluoxetine + Etophylline: 1 (0.6%)
Anti-Parkinsonian	**Drugs**
Dopaminergic agonist	Pramipexole: 1 (0.6%)
Dopamine facilitator	Amantadine: 1 (0.6%)
Dual therapy	Levodopa + Carbidopa: 2 (1.3%)
Anti-ulcer	**Drugs**
Proton pump inhibitors	Pantoprazole: 58 (38.6%) Omeprazole: 14 (9.3%) Rabeprazole: 12 (8%) Esomeprazole: 7 (4.6%) Lansoprazole: 1 (0.6%)
H_2 antagonist	Ranitidine: 9 (6%)
Cytoprotective agent	Sucralfate: 3 (2%)
Anti-emetics	**Drugs**
	Ondansetron: 21 (14%) Prochlorperazine: 1 (0.6%)

	Cinnarazine: 1 (0.6%)
Anthelmintic	Albendazole: 1 (0.6%)
Antifungal	Metronidazole: 11 (7.3%) Ketoconazole: 1 (0.6%) Allylamines- Terbinafine: 1 (0.6%)
Antibacterials	**Drugs**
Penicillins	Ampicillin: 1 (0.6%)
Quinolones	2nd generation- Levofloxacin: 2 (1.3%), Moxifloxacin: 1 (0.6%)
Cephalosporins	2nd generation- Cefuroxime: 8 (5.3%) 3rd generation :- Ceftriaxone: 14 (9.3%) Cefotaxime: 3 (2%)
Carbapenems	Meropenem: 2 (1.3%) Feropenem: 1 (0.6%)
Macrolides	Azithromycin: 2 (1.3%)
Lincosamide	Clindamycin: 8 (5.3%)
Dual therapy	Amoxicillin + Clavulanic acid: 11 (7.3%) Piperacillin + Tazobactam: 11 (7.3%) Cefuroxime + Sulbactam: 5 (3.3%) Cefpodoxime + Clavulanic acid: 3 (2%) Ceftazidime + Sulbactam: 2 (1.3%) Cefuroxime + Clavulanic acid: 1 (0.6%) Sulfamethazole + Trimethoprim: 1 (0.6%)
Anti-epileptics	**Drugs**
Cyclic GABA analogues	Pregabalin: 1 (0.6%) Levetiracetam: 1 (0.6%)
Hydantoin	Phenytoin: 1 (0.6%)
Vitamins	**Minerals**
Multivitamins: 15 (10%) Vitamin B12: 4 (2.6%) Mecobalamine: 2 (1.3%) Protein powder: 2 (1.3%) Vitamin K: 1 (0.6%)	Potassium chloride: 4 (2.6%) Calcium carbonate: 3 (2%)
Cough Syrups	**Laxatives**
Phenylepherine + chlorpheniramine maleate: 2 (1.3%) Guaiphenesin + Terbutaline + Bromhexine: 1 (0.6%) Bromhexine: 1 (0.6%) Dextromethorphan + Chlorpheniramine: 1 (0.6%)	Milk of magnesia + Liquid paraffin: 3 (2%) Bisacodyl: 1 (0.6%) Lactulose: 2 (1.3%)
Anti-Diarrhoeals	Lactobacillus + Calcium pentothenate + niacinamide + Vit B12 + Vit C + Folic acid + Vit B6 + Vit B2 + Thiamine mononitrate: 1 (0.6%) Lactobacillus: 7 (4.6%)
Anti-Platelets	**Anti-Fibrinolytics**
Cilostazol: 4 (2.6%)	Tranexamic acid: 1 (0.6%)
CNS stimulants	**Anti-inflammatory agents**
Piracetam + Ginko biloba + Vinpocetine: 3 (2%) Epalrestat + Methylcobalamine: 1 (0.6%)	Trypsin + Chymotrypsin: 5 (3.3%) Trypsin + Bromelain + Rutoside: 4 (2.6%) Chymotrypsin: 1 (0.6%)
Anti-Thyroid	**Antibiotics**
Levothyroxine: 4 (2.6%) Methimazole: 1 (0.6%)	Oxalinediones- Linezolid: 2 (1.3%)
Others	
Phoshodiesterase 5 inhibitors	Tadafil: 1 (0.6%)
Electrolyte replenishers	Normal saline: 8 (5.3%), Dextrose: 1 (0.6%)
Tetracyclines	Tetracycline: 1 (0.6%)
Cycline diphosphate choline	Citicholine: 6 (4%)
Hyponatremic drug	Tolvaptan: 1 (0.6%)
Prokinetic agents	Metoclopramide: 1 (0.6%)
Xanthine oxidase inhibitor	Febuxostat: 2 (1.3%)
Adrenergic alpha antagonist	Sildosin: 2 (1.3%)
Anti-malarial	Artesunate: 1 (0.6%)
Anti-vertigo	Betahistine: 1 (0.6%)
Hypnotic agent	Diprivan: 1 (0.6%) Zolpidem: 1 (0.6%)
Antiseptic oral rinse	Chlorhexidine gluconate: 1 (0.6%)
Cholelitholytics	Ursodeoxycholic acid: 1 (0.6%)
Anti-acidic drug Anti-hyperphosphatemia BPH drug Neuropathic pain drug	Sodium bicarbonate: 4 (2.6%) Sevelamar: 2 (1.3%) Tamsulosine + Dutasteride: 1 (0.6%) Gabapentin + Methylcobalamine: 1 (0.6%)

6.4 DOMINATING CARDIOVASCULAR COMPLICATIONS IN T2DM PATIENTS

Ischemic heart disease (IHD), myocardial infarction (MI), congestive heart failure (CHF), HTN and dyslipidemias control chronic complications of diabetes, requiring extensive drug therapy along with lifestyle changes. They represent a far greater burden on both patients with T2DM and overall medical costs than T2DM itself.

The commonly occurring CV complication was HTN which constituted about 46.6% of total patients. The next CV complication was IHD with HTN. The remaining results are given in Table 5.

Table 5- Prevalence of cardiovascular complications in T2DM patients

Type of Diagnosis	Number (%)
T2DM	39(26%)
T2DM with HTN	70(46.6%)
T2DM with HTN and IHD	22(16.1%)
T2DM with IHD	6(4%)
T2DM with HTN and Stroke	3(2%)
T2DM with HTN, IHD, Atherosclerosis	2(1.3%)
T2DM with Angina	2(1.3%)
T2DM with Atherosclerosis	1(0.6%)
T2DM with HTN and Atherosclerosis	1(0.6%)
T2DM with IHD and Stroke	1(0.6%)
T2DM with Stroke	1(0.6%)
T2DM with MI	1(0.6%)
T2DM with IHD and Atherosclerosis	1(0.6%)

6.5 DIAGNOSTIC AND MEDICATION COSTS OF STUDY POPULATION

During the interview, the costs were focused on patient comments, then Labs, Doctors' reviews and Medicine costs were validated from referable records. The average cost of medical visits, laboratory tests and drug costs was up to ₹300/visit, ₹400/test and ₹1100/visit sequentially.

6.5.1 Diagnosis cost

The consultation cost was based on the type of health specialist they preferred to consult. It also included laboratory cost. The average diagnosis cost of a diabetic patient was ₹4516.45. A patient with both IHD and Stroke had to spend an average of ₹5755.0. For a Hypertensive patient the average diagnosis cost was ₹4708.86 and of an Atherosclerotic patient was ₹1600.

Laboratory cost was the major contributing factor towards the diagnosis cost of a CVD patient.

5.5.2 Medication costs

Medication costs included all the drugs involving oral, topical, ophthalmic and parenteral drugs including tablets, infusions, ointments, eye drops, syrups injections etc. The average medication cost of a T2DM patient was ₹4551.381. A T2DM patient with IHD and Atherosclerosis had to spend ₹5222.0 followed by patients with HTN and IHD that was ₹4938. T2DM patient only with HTN had to pay ₹4559.278.

Anti-coagulants in Atherosclerotic patients contributed to the high medication cost among them. While in a Hypertensive patient, injectable anti-hypertensive drugs added up the cost.

The disease wise diagnosis and medication cost of patients were mentioned in the following Table 6.

Table 6- Diagnosis and medication cost of T2DM patient with and without cardiovascular complications.

Condition	Mean Diagnosis cost	Mean Medication cost
T2DM	₹ 4516.45	₹ 4551.381
T2DM with HTN	₹ 4708.86	₹ 4559.278
T2DM with HTN and IHD	₹ 3999.77	₹ 4938.866
T2DM with IHD	₹ 3203.83	₹ 4543.118
T2DM with HTN and Stroke	₹ 4341.67	₹ 3335.824
T2DM with HTN, IHD, Atherosclerosis	₹ 2772.5	₹ 4194.745
T2DM with Angina	₹ 1710	₹ 43.86
T2DM with Atherosclerosis	₹ 1600	₹ 439
T2DM with HTN n and Atherosclerosis	₹ 10755	₹ 226.22
T2DM with IHD and Stroke	₹ 5755	₹ 255.95
T2DM with Stroke	₹ 3775	₹ 52.515
T2DM with MI	₹ 3035	₹ 3988.34
T2DM with IHD and Atherosclerosis	₹ 3440	₹ 5222.0
Total	₹ 4124.08	₹ 2796.23

6.6 DIRECT HEALTH CARE COST FOR STUDY POPULATION

Direct costs comprise of medical costs and non-medical costs. Medical costs includes medication costs, consultation costs, bed cost, surgical costs, lab cost and other expenses such as cost of syringes, cannula and Diabetic footwear if any.

Non-medical costs include transportation and food costs.

The direct medical cost for patients with T2DM was ₹11957.2. The direct medical cost was highest in patients with Stroke as complication i.e. ₹73827. The contributory factor was surgical cost. Patients with HTN as a complication had to pay an average of ₹17936.6 totally as direct cost. A patient with T2DM and IHD + HTN had to pay around ₹16602.3. The health expenditure for a T2DM patient suffering from IHD was ₹9090.65. For a T2DM patient with both IHD and Atherosclerosis had to spend approximately ₹54675.3. Approximately ₹2853 was given by a T2DM patient with Angina.

From the analysis the health expenditure of a CVD patient mainly infers to the surgical cost and laboratory cost.

From the data it is also evident that the sole expenditure to manage T2DM is drastically increasing if the patient is thought to have a combination of CV complication.

The mean non-medical cost in T2DM patients as well as Diabetic patients with CV complications was found to be ₹1399.67. The mean direct cost of study participants is given in the following Table 7.

Table 7- Mean direct costs of study subjects

Condition	Average Medical cost	Average Non-medical cost
T2DM (n=39)	₹ 11957.2	₹ 2266.92
T2DM with HTN (n=70)	₹ 17936.6	₹ 1925.43
T2DM with HTN and IHD (n=22)	₹ 16602.3	₹ 1640
T2DM with IHD (n=6)	₹ 9090.65	₹ 1288.33
T2DM with HTN and Stroke (n=3)	₹ 11242.6	₹ 1710
T2DM with HTN, IHD, Atherosclerosis (n=2)	₹ 54675.3	₹ 940
T2DM with Angina (n=2)	₹ 2853.86	₹ 725
T2DM with Atherosclerosis (n=1)	₹ 51300	₹ 480
T2DM with HTN and Atherosclerosis (n=1)	₹ 52228	₹ 600
T2DM with IHD and Stroke (n=1)	₹ 8110.95	₹ 1550
T2DM with Stroke (n=1)	₹ 73827	₹ 1150
T2DM with MI (n=1)	₹ 9516.94	₹ 1800
T2DM with IHD and Atherosclerosis (n=1)	₹ 59690.5	₹ 2120
Total	₹ 29156.3	₹ 1399.66

6.7 A CORRELATION OF DIRECT COST AND EDUCATIONAL STATUS OF PATIENTS

The educational level stratification of the total treatment cost makes it clear that people who had higher qualification i.e. professional qualification professional spent much on treatment rather than the illiterate people. This is mainly as the professionals preferred private and semi-private wards rather than general ward, which added up to the medical cost as duration of hospital stay increased (Table 8).

Table 8- Educational level stratification of direct costs

Level of education	Average Direct costs
Professional	₹ 19217.1
Graduation	₹ 18912.5
School	₹ 17787.82
Illiterate	₹ 17013.3

6.8 TRANSPORTATION COST AND COST OF HOSPITAL WARD

Patients from all over Mangaluru who were admitted in the hospital during the study period were considered. The average transportation cost was calculated and for the patients (86%) who preferred own vehicles, mostly four wheelers was ₹231.4. 42.7% of patients were admitted in general wards, 28% in semiprivate and 29.3% in private wards. General ward have been charged ₹300 per day, semi-private allotted ₹600 per day and patient in private wards had to pay ₹900 per day. Mean cost of transportation and cost of hospital ward for per patient can be observed in following Table 9.

Table 9- Mean transportation cost and cost of hospital ward per patient.

Mode of transport Number (150)	Percentage	Average transportation cost
Own 129	86%	₹ 231.4
Public 21	14%	₹ 238.467
Type of Ward Number (150)		**Cost per day**
General 64	42.7%	₹ 300
Semi-private 42	28%	₹ 600
Private 44	29.3%	₹ 900

6.9 INDIRECT HEALTH CARE COSTS FOR STUDY POPULATION

The days lost for the subjects were dependent on the duration of hospital stay and severity of disease. The cost associated with days lost from work lost during the days stayed at hospital is considered under productivity loss. It is calculated by; Wage/hour × Total hours work × Number of days lost. Average days lost per patient and per caretaker are tabulated in Table 10.

Table 10- Average days lost per patient and caretaker.

Income range	Average days lost for patient	Number	Average days lost for caretaker	Number
0	1	30	6	41
Up to 5000	6	11	5	7
5001-7500	6	22	6	15
7501-10000	6	45	6	23
10001-20000	6	16	6	32
20001-50000	6	21	6	29
50001-100000	6	8	5	3
>100000	12	1	0	0

A patient and caretaker having income of Rupees up to 5000 per month had loss of ₹ 950.495 approximately related to number of days stayed in the hospital.

While for an income range of ₹ 5001-7500 per month, ₹ 4568.24 has been lost, followed by a patient with income range of ₹ 7501-10000 per month, who lost ₹9124.

The severity and complication of the disease lead to more number of days of stays in hospital thereby leading to a hike in productivity loss and apparently parallel increase in indirect cost. Tabulation of average of total indirect costs of patient and caretaker is shown in Table 11.

Table 11- Mean total indirect costs of patient and caretaker classified according to income

Income of patient	Number	Productivity loss of patient	Productivity loss of caretaker	Total mean loss
0	30	0	₹ 11967	₹ 11967
Up to 5000	11	₹ 628.536(15.2%)	₹ 321.959	₹ 950.495
5001-7500	22	₹ 1382.69(56.4%)	₹ 3185.55	₹ 4568.24
7501-10000	41	₹ 3587.3(39.8%)	₹ 5537	₹ 9124.77
10001-20000	16	₹ 8312.75(20%)	₹ 5208.4	₹ 13521.3
20001-50000	21	₹ 21888.6(11.8%)	₹ 11105	₹ 32993.6
50001-100000	8	₹ 35625.2(5.2%)	₹ 14791.7	₹ 50416.9
Above 100000	1	₹ 600000(39.9%)	₹ 10000.3	₹ 610000
Total	150	₹ 83928.135	₹ 7764.61	₹ 91692.78

6.10 TOTAL EXPENSES SPENT BY THE STUDY PARTICIPANTS

Total expenditure of a T2DM was found to be ₹ 73107. Patient with T2DM alongside HTN + IHD had to spend ₹ 78636, while an IHD patient spent ₹ 75329. A patient with T2DM + Stroke paid ₹ 73828. A Hypertensive patient had to give ₹ 73233. Total expenditure of T2DM patient with IHD + Atherosclerosis was around ₹ 53732 followed by ₹ 52795 given by a HTN + Atherosclerotic patient. Approximately ₹ 52972 was given by a T2DM + Atherosclerotic patient. A T2DM patient having both Stroke and HTN had to spend ₹ 23900. A total of ₹ 22885 and ₹ 22784 had to be spent by a T2DM patient with Angina and T2DM patient with MI respectively.

From the above data, the economic burden is found to be relatively high on patients having single or combination of CVD with T2DM as well. From the analysis

it was found that a patient with average income spends about 15% of his monthly income as his disease management expenditure. Average of Direct and Indirect expense per patient are shown in Table 12.

Table 12- Mean of total costs (Direct + Indirect) per person

Condition	Average of total cost
T2DM	₹ 73107
T2DM with HTN	₹ 73233
T2DM with HTN and IHD	₹ 78636
T2DM with IHD	₹ 75329.58
T2DM with HTN and Stroke	₹ 23900
T2DM with HTN, IHD, Atherosclerosis	₹ 19903
T2DM with Angina	₹ 22885
T2DM with Atherosclerosis	₹ 52972
T2DM with HTN and Atherosclerosis	₹ 52795
T2DM	₹ 11176
T2DM with Stroke	₹ 73828
T2DM with MI	₹ 22784
T2DM with IHD and Atherosclerosis	₹ 53732
Total	₹ 48790.81

6.11 LIFESTYLE CHANGES AND MODALITIES

Out of 150 study participants, 125 patients followed their lifestyle changes while remaining 25 did not. Out of 125 patients, 70 patients practiced regular exercise, 48 patients had done changes in their diet and 81 patients adopted DASH i.e. Dietary Approaches to Stop Hypertension. 55 patients did not do exercise, 77 did not change their diet according to specific comorbidity and 44 of them did not follow DASH plan. The lifestyle modifications followed by study population are tabulated in Table 13.

Table 13- Trend of lifestyle modifications in study subjects

Lifestyle modification	Yes : 125	No : 25
Exercise	Yes : 70	No : 55
Diet	Yes : 48	No : 77
DASH	Yes : 81	No : 44

6.12 THE IMPACT OF NON-PHARMACOLOGICAL APPROACH

The impact of non-pharmacological approach was assessed by comparing the total drug cost. Out of 125 patients who followed lifestyle modifications it was found that patients followed exercise, diet and DASH (n=1) had least cost of medication i.e. ₹ 1938.6. Patient who followed only exercise and DASH plan (n=38) had a medication cost of ₹ 4540.141 and the remaining patients (n=13) who followed only diet had an average medication cost of ₹ 4647.04. Therefore the patients who strictly practiced routine lifestyle changes had to give less money out of their pockets than those who did not practice routine lifestyle changes.

Relationship between average medication cost and lifestyle modification can be observed in Table 14.

Table 14- Relationship between average medication cost and lifestyle modification

Exercise	Diet	DASH	Number	Average medication cost/person
Yes	Yes	Yes	1	₹ 1938.6
Yes	Yes	No	2	₹ 2375.242
No	Yes	Yes	32	₹ 4436.873
Yes	No	Yes	38	₹ 4540.141
Yes	No	No	29	₹ 4551.389
No	Yes	No	13	₹ 4647.04
No	No	Yes	10	₹ 4762.39
No	No	No	25	₹ 4907.75

From the data it is clear that people who follow all the lifestyle modification had a decreased total medication compared to others. Improved treatment plan can be implemented in patients with T2DM and CV complication with proper combination of medication and lifestyle modification.

7.0 DISCUSSION

As the number of people with Diabetes is rising worldwide, the condition is taking an ever-increasing proportion not only of the household budgets of the patient but also of the overall healthcare budget. Without primary prevention the epidemic of diabetes will continue to grow even worse. In the next 25 years, T2DM is expected to become one of the biggest disablers and killers in the world. Immediate action is needed to stop the T2DM tide and incorporate cost-effective treatment approaches to reverse the trend. As a whole, T2DM management can be an expensive affair. We collected data from case files of patients with T2DM and cardiovascular complications which consisted of laboratory investigations, treatment chart information and interviewing patients or patient care takers. A total of 150 validated DCF was filled accordingly. Among the 150 cases, 93

patients were male (62%) and 57 patients were female (38%).

A research by Grover S et al. found that the average cost of treatment was significantly higher for those who were more educated, for those who visited the hospital more often, and for those who obtained more medications.[19] Our study also supports that patients who were educated were more aware about disease and they preferred to stay in private and semi-private wards rather than general which adds up to the treatment cost when duration of hospital stay increases.

In our study the most commonly occurring CV complication was HTN which constituted about 46.6% of total patients followed by IHD with HTN, HTN with Stroke and Angina. According to a study conducted by Rungby J et al., the most commonly reported diagnosis of CV was Ischemic heart disease with Angina Pectoris (32.9%) accompanied by Acute cerebral ischemia or Stroke (30.6%), MI (25.7%), IHD without Angina pectoris (20.5%), and Atherosclerosis / peripheral vascular disease (19.3%). 18.8% of the patients were diagnosed with atrial fibrillation and 66.3% with hypertension.[21] It was because T2DM patients also have dangerous levels of cholesterol including high LDL cholesterol, low HDL cholesterol and elevated Triglycerides. The trait of low lipid counts also occurs in premature heart disease patients. This is also a symptom of an insulin resistance associated lipid disorder.

From a study conducted by Shruti VB et al., among these patients, the most commonly prescribed OHA was Metformin, preferred as monotherapy as well as for combined therapy with other OHA, such as Pioglitazone, Rapaglinide, Glimepiride and Glipizide, respectively, which met the patients ' needs and the doctor's preference. In our study also Metformin was used as monotherapy by 18% of patients from Biguanides class of drugs and was the most commonly used OHA. Glimepiride and Gliclazide was received by 8% and 6% of patients respectively from sulfonylureas category followed by Gliptins , Teneligliptin used by 2% and 1.3% of total individual received Vildagliptin and Linagliptin. Combination therapy of Glimepiride + Metformin was consumed by 11.3% followed by Teneleglipti n /Vildagliptin/ Sitagliptin + Metformin by 4.6% of patients. Metformin was a drug of choice because it reduces the amount of glucose in blood by increasing absorption from cell and improves the body's use of insulin.

Their study also found that the widely used antibiotics for the treatment of comorbid infections included the combination of Cefoperazone + Sulbactam, Piperacillin + Tazobactam, Amoxicillin + Clavulanic acid, Amoxicillin, Levofloxacin, Ciprofloxacin, Norfloxacin and Azithromycin.[22] In our study Ceftriaxone which is from cephalosporin category was given the most i.e. 9.3%, followed by Clindamycin to 5.3% of patients. Meropenem and Azithromycin from Carbapenems and Macrolides category respectively was consumed by 1.3% of patients each. Dual therapy of Amoxicillin + Clavulanic acid and Piperacillin + Tazobactam was given to 7.3% of individuals respectively. Ceftriaxone has outstanding action against many gram-negative micro-organisms, and fair behavior against most gram-positive micro-organisms. Ceftriaxone's long elimination half-life has permitted twice and once daily administration, potentially leading to significant cost savings. Thanks to its reported effectiveness, protection, and easy dosing schedule, Ceftriaxone is the 3rd generation cephalosporin most favored for the treatment of various infections.

Our study found that the total average diagnostic cost and medication cost was ₹ 4124.08 and ₹ 2796.23 respectively. Clara Bermudez-Tamayo C *et al.,* conducted a study in which the diagnostic cost was $ 42.1 (8.3) and medication cost was $ 13.8 (2.3). In our study a patient and caretaker having income of Rupees up to 5000 per month had a productivity loss of ₹ 950.495 approximately related to the

number of days stayed in the hospital. While for a patient with an income range of ₹ 5001-7500 per month, ₹ 4568.24 has been lost which was followed by a patient with income range of ₹ 7501-10000 per month. In support a study done by Clara Bermudez-Tamayo *et al.*, Productivity loss for patient was $101.5 (17.8) and for caregiver was $36.7 (14.8). [23]

The study done by Eristina *et. al.*, medication cost was ₹ 352,940 and diagnosis cost was ₹ 67,788.00.[24] American Diabetes Association (ADA) study data (2012) showed that the largest components of medical expenditures are hospital inpatient care (43% of the total medical cost), prescription medications to treat the complications of diabetes (18%), anti-diabetic agents and diabetic supplies (12%). The diagnosis cost mainly points out the costs of laboratory findings of the patients which increase according to the severity of comorbidity as well as duration of hospital stay.

In our study we found that the direct cost increased drastically with the combination of CV complication along with T2DM. The direct medical cost for patients with T2DM was ₹ 11957.2. The direct medical cost was highest in patients with stroke as complication i.e. ₹ 73827 which was about 5 times the expenditure of a person with T2DM only. From the data it is evident that the sole expenditure to manage T2DM is drastically increasing if the patient is thought to have a combination of CV complication. The CODE-2 European multicenter study observed that the presence of macro vascular complication increased the direct cost per patient by 2.0 times compared with patients without complications.[25] Length of hospital stay of patient suffering from stroke, medications to treat stroke especially blood thinners like t-Pa and surgery like embolectomy to remove the clot can elevate the expenses.

Our study shows that the overall healthcare costs were found to be higher in the patients with more than three complications, which may be due to the more number of medications, laboratory investigations, consultations and hospitalization. In the present study, there was a positive relationship between increased costs of health care services with increased number of complications. In addition, the average healthcare costs were significantly increased with the increased length of the stay of the patients in the hospital. Admission to the hospital accounts for the greatest part of the cost of diabetes; in addition, the extra-need for inpatient hospital care for patients who have acquired late complications can greatly affect cost, as hospital bed costs per day have relatively high unit costs compared to other services and total medication costs. In addition, most diabetics consuming OHA will receive insulin for complications shortly after hospital admission and this will further increase the costs. Similar kind of results were found by Akari S *et al.*, study.[26]

In our study a patient and caretaker having income of Rupees up to 5000 per month had a productivity loss of ₹ 950.495 approximately related to the number of days stayed in the hospital. While for a patient with an income range of ₹ 5001-7500 per month, ₹ 4568.24 has been lost which was followed by a patient with income range of ₹ 7501-10000 per month. In support a study done by Clara Bermudez-Tamayo *et al.*, Productivity loss for patient was $101.5 (17.8) and for caregiver was $36.7 (14.8). [23]

From an article by Caro J *et al.*, Complications management generates substantial costs in T2DM. The main component of these costs is macrovascular disorder, and they are incurred much earlier than those related to microvascular complications. Reducing the chances of macro-vascular complications should therefore also reduce the expense of complications. The effectiveness of the care plan used to achieve the lower costs would depend on how it results in net savings. This approach would tackle the cardiovascular disease risk factors such as smoking, high blood pressure and hypercholesterolemia; It is not yet certain that better glycaemic

regulation will also benefit, but recent epidemiological evidence indicates that postprandial glucose-related macrovascular disease is.[27] From our data it is clear that patients who strictly follow all the lifestyle modification had a lower total medication compared to patients who did not follow any cost lifestyle modifications.

8.0 CONCLUSION

Demand for economic research will continue to rise due to the need to evaluate the increasing number of available therapies to prevent and treat diabetes and related cardiovascular complications. Furthermore, future economic studies will continue to expand the research field. For example, economic analysis may analyze how diabetes and its complications are correlated with such economic factors as income and education level, lifestyle selection and knowledge of the value of the control. Economic analyses indicate that diabetes is a very expensive disease, and that strategies to prevent and manage diabetes can vary considerably in terms of the cost per health outcome. Health practitioners and policy-makers should use this knowledge to make clinical and policy decisions and enable effective use of resources. Efforts are required to improve the standard of economic studies and to broaden potential economic research into new fields. As the pressure due to CVD and T2DM rises in India, more households will be exposed to these financial strains and, sadly, the most severely affected will be the economically disadvantaged among them. While primary prevention of these conditions needs more focus, insurance policies that target the poor also have an important role to play in protecting disadvantaged households financially. With the Indian diabetic population expected to grow to over 80.9 million by 2030, rapid reform and investment in health policy will be needed if limited health-care resources with corresponding economic constraints are to be made the best use.

9.0 BIBLIOGRAPHY

1. Bootman JL, Townsend RJ, McGhan WF. Principles of pharmacoeconomics. 2nd ed. Cincinnati: Harvey Whitney Books. 1996; 7: 4–20.
2. Jefferson T, Demicheli V, Mugford M. Cost-of-illness studies, elementary economic evaluation in health care. 2nd Ed. London: BMJ Publishing Group. 2000; 5: 17–29.
3. Kumpatla S, Kothandan H, Tharkar S, Viswanathan V. The costs of treating long-term diabetic complications in a developing country: a study from India. J. Assoc. Physicians India. 2013; 61: 102–09.
4. Elrayah-Eliadarous. H. Economic burden of diabetes on patients and their families in Sudan. Stockholm. 2007; 171: 10-13.
5. Bilous R, Donnelly R. Introduction to diabetes. Handbook of Diabetes, 4th edition. 2010; 8: 1-4.
6. World Health Organization. Global reports on Diabetes. 2016; 20: 5-6.
7. Kaiser A, Zhang N, Der Pluijm W. Global Prevalence of Type 2 Diabetes over the Next Ten Years (2018-2028). Diabetes. 2018; 67: 202.
8. International Diabetes Federation. Diabetes in South-East Asia. IDF SEA. 2018; 8: 2.
9. Whiting, D.R. IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030. Diabetes. Res. Clin. Pract. 2011; 94: 311–21.
10. International Diabetes Federation. IDF diabetes atlas, epidemiology and research. 7th edition. Brussels, Belgium: international Diabetes Federation. 2015; 13: 6.
11. Einarson TR, Acs A, Ludwig C, Panton UH. Economic Burden of Cardiovascular Disease in Type 2 Diabetes: A Systematic Review. Value Health. 2018; 21: 881-90.
12. International Diabetes Federation. Diabetes and cardiovascular disease. Brussels: International Diabetes Federation. 2016; 10: 41–44.
13. World Health Organization. Global Health Expenditure Database. Total health expenditure (THE) % Gross Domestic Product (GDP). 2012; 20: 7-22.
14. The Economic Times. Cardiovascular disease, diabetes may cost India $6.2 trillion. 2018; 20: 5-10.
15. Singh J. Economic Burden of Diabetes. Medicine Update. 2013; 23: 205-08.

16. Yesudian CA, Grepstad M, Visintin E. The economic burden of diabetes in India: A review of the literature. Global Health. 2014; 10: 80.
17. Shrivastava U, Misra A, Mohan V, Unnikrishnan R, Bachani D. Obesity, Diabetes and Cardiovascular Diseases in India: Public Health Challenges. Current diabetes reviews. 2016; 13: 65–80.
18. Chauhan S, Aeri, B. T. The rising incidence of cardiovascular diseases in India. Journal of Preventive Cardiology. 2015; 4(4): 735-39.
19. 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; 81 (956): 391-95.
20. Einarson TR, Acs A, Ludwig C. Prevalence of cardiovascular disease in type 2 diabetes: a systematic literature review of scientific evidence from across the world in 2007-2017. Cardiovasc Diabetol. 2018; 17: 83-85.
21. Rungby J, Schou M, Warrer P, Ytte L, Andersen GS. Prevalence of cardiovascular disease and evaluation of standard of care in type 2 diabetes: a nationwide study in primary care. Cardiovasc Endocrinol. 2017; 6: 145–51.
22. Shruti V.B, Bhagya M.S, Ashok K.N. A prospective study on drug utilization pattern & rationality in treatment of type II diabetes mellitus: a population based analysis. International Journal of Research in Medical Sciences. 2014; 2(3): 983-87.
23. Bermudez- tamayo C, Besançon S, Johri M et al. Direct and indirect costs of diabetes mellitus in Mali: a case-control study.PLos ONE. 2017:12(5): 18-20
24. Eristina, T M Andayani, R A Oetari. Direct medical cost and utility analysis of diabetics outpatient at Karanganyar public hospital. IOP science. 2017; 259: 12-13.
25. Massi-Benedetti M. The cost of diabetes type II in Europe: the CODE-2 study. Diabetologia. 2002; 45: 1-10.
26. Akari S, Mateti UV, Kunduru BR. Health-care cost of diabetes in South India: A cost of illness study. Journal of research in pharmacy practice. 2013; 2(3): 114-17
27. Caro J, O'Brien J, Hollenbeak C, Spackman E, Ben Joseph R, Okamoto L et al. Economic burden and risk of cardiovascular disease and diabetes in patients with different cardiometabolic risk profiles. Value in Health. 2007; 10: 12–20.

How to cite this article: Banu S, Baburaj A, Johncy N et.al. A study on cost analysis in diabetic patients with cardiovascular complications in a tertiary care teaching hospital. Int J Health Sci Res. 2020; 10(4):13-28.

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