ANALYSING MARKET POTENTIAL AND PREFERENCE OF DAPAGLIFLOZIN OVER OTHER DRUGS USED IN TYPE 2 DIABETES

A Thesis

Submitted in partial fulfilment of the requirements for the
Degree of

Master of Business Administration

(Pharma Management)

Submitted by

Kundan Kumar

Batch 2021-2023

SCHOOL OF PHARMACEUTICAL MANAGEMENT

Indian Institute of Health Management Research (IIHMR) University

Jaipur, India

SCHOOL OF PHARMACEUTICAL MANAGEMENT

Indian Institute of Health Management Research (IIHMR) University
Jaipur, India

DECLARATION

I hereby declare that the present work embodied in this thesis entitled, "**ANALYSING MARKET POTENTIAL AND PREFERENCE OF DAPAGLIFLOZIN OVER OTHER DRUGS USED IN TYPE 2 DIABETES**" has been carried out by me under the direct supervision Dr.Sudhinder Singh Chowhan, Associate Professor, School of pharmaceutical management Indian institute of health management research (IIHMR) university, Jaipur, India This work has not been and will not be submitted in part or in full in any other university or institution for any degree or diploma or to any other organization for commercial purpose.

Date: June 07, 2023

Kundan Kumar (IIHMR-U/02/2021-23/0312)

Place: Indian institute of health management research (IIHMR) university, Jaipur India

SCHOOL OF PHARMACEUTICAL MANAGEMENT

Indian Institute of Health Management Research (IIHMR) University
Jaipur, India

CERTIFICATE

This is to certify that the work entitled **"ANALYSING MARKET POTENTIAL AND PREFERENCE OF DAPAGLIFLOZIN OVER OTHER DRUGS USED IN TYPE 2 DIABETES**" has been carried out by Kundan Kumar under my direction and supervision.

Date: June 07, 2023

Dr. Sudhinder Singh Chowhan

Place: Indian institute of health management research (IIHMR) university, Jaipur India

ACKNOWLEDGEMENT

Firstly, I would like to express my sincere and heartiest gratitude to Dr. Sudhinder Singh Chowhan Associate Professor,. School of pharmaceutical management Indian institute of health management research (IIHMR) university, Jaipur, India for his constant support and guidance throughout the major research project. I am very grateful for the time you gave me for clearing my doubts and correcting my mistakes. It was an incredible work experience to work with you.

I would also extend my gratitude to, Dr.Saurabh Kumar Banerjee, Dean & Associate Professor, who encouraged and supported me at all times during my journey in IIHMR.

I owe my wholehearted thanks to my MBA-PM-13 batchmates for their cooperation and assistance.

KUNDAN KUMAR

LIST OF ABBREVIATIONS

CAGR	Compound Annual Growth Rate
FDI	Foreign Direct Investment
PMJAY	Pradhan Mantri Jan Arogya Yojana
API	Active Pharmaceutical Ingredient
HCQ	Hydroxychloroquine
DM	Diabetes Mellitus
IFG	Impaired Fasting Glucose
NAFLD	Non-Alcoholic fatty Liver Disease
CODI	Cost of Diabetes in India
FY	Financial Year
SGLT2	Sodium Glucose Cotransporter 2
T2D	Type 2 Diabetes
T1D	Type 1 Diabetes
BMI	Body Mass Index
IDF	International Diabetes Federation
IGT	Impaired Glucose Tolerance
MACE	Major Adverse Cardiovascular Event
OHA	Oral Hypoglycaemic Agent
CGM	Continuous Glucose Monitoring
DKA	Diabetic Ketoacidosis
SEM	Structure Equation Modelling
ANOVA	Analysis of Variance

EXECUTIVE SUMMARY

The Anti-Diabetic market in India is valued at 17 billion in 2021, and is expected to reach 60 billionby 2031 expanding at a compound annual growth rate (CAGR) of ~16.06%. In recent years India has witnessed COVID 19 pandemic and it has transformed the Diabetes care market in many terms.Rising awareness about lifestyle diseases and increasing preference in favour of chemical free naturalproducts as well as favourable government initiatives have led to expansion of diabetes care marketIndia.

The main purpose of the study was to examine the Physician behaviour towards Dapagliflozin, in all over India, the research was done by primary research method by help of questionnaire survey and analysis of the data done by the response of the survey. Physician preference towards anti diabetic drugs and factors affecting physician prescription related questions were formed and analysis of them were done in the research.

The study intended to utilize T- test, and ANOVA to study relationship between the demographics of the respondents and their preferences for various clinical, non-clinical and market factors which affect their prescription behaviour. The Diabetes care market in India is changing very rapidly and new players are making their space in this industry and drug market is also following the trend.

It can be easily seen in the product portfolio of many established companies like Abbott, Sanofi, Novo Nordisk, Intas, Boehringer Ingelheim, Sun Pharma, Lupin that their top sales generating brands are anti diabetes brands and the introduction of Insurance in diabetic space has also given a boost to innovator molecules being accepted for treatment of diabetes in India. Many companies like BeatO and twin are targeting Diabetes space in India and giving more personalized support to diabetes patients in India.

There are still many problems that require an immediate attention when it comes to diabetes like Lifestyle of patients, Dietary habits and early diagnosis and treatment of prediabetes patients. The government has taken many initiatives like PMJAY and Ayushman Bharat Schemes to tackle increasing diabetes prevalence in India and it can be solved by more and more contribution of common people and healthcare stakeholders.

Table of Contents

Contents

List of Figures

List of Tables

CHAPTER 1

INTRODUCTION

1.INTRODUCTION

1.1 Introduction to Indian Pharmaceutical Industry

Indian pharmaceutical industry is known for its generic medicines and low-cost vaccines globally. Transformed over the years as a vibrant sector, presently Indian Pharma ranks 3rd in pharmaceutical production by volume. In the past few years, Indian Pharma sector has grown steadily by CAGR of 9.43%. Pharma sector has been consistently earning trade surplus. During 2020-21, total pharma export was ₹180555 crore (USD 24.35 Bn) against the total pharma import of ₹49436 crore (USD 6.66 Bn), thereby generating trade surplus of USD 17.68 Bn. Till end September 2021, total pharma export has been ₹ 87864 crore (USD 11.88 Bn) as against total import of ₹ 33636 crore (USD 4.66 Bn), thereby generating a trade surplus of USD 7.22 Bn.

Major segments of Indian Pharmaceutical Industry include generic drugs, OTC medicines, bulk drugs, vaccines, contract research & manufacturing, biosimilars and biologics. Indian pharmaceutical industry also plays significant role globally. India has the highest number of United States Food and Drug Administration (USFDA) compliant Pharma plants outside of USA. There are 500 API manufacturers contributing about 8% in the global API Industry. India is the largest supplier of generic medicines with 20% share in the global supply by manufacturing 60000 different generic brands across 60 therapeutic categories. Access to affordable HIV treatment from India is one of the greatest success stories in medicine. India is one of the biggest suppliers of low-cost vaccines in the world.

The Indian pharma industry has also played an important role in meeting the challenges for mitigation of the infection in COVID pandemic. The industry worked in close collaboration with the government and academic institutes etc., to quickly develop and refine manufacturing processes which helped to ensure a consistent supply of medicines needed for the management of COVID-19 (e.g., Remdesivir, Ivermectin, Hydroxychloroquine, Dexamethasone, Tocilizumab, Favipiravir etc.). Indian drug supplies throughout the COVID-19 pandemic period have provided relief to over 120 countries for Hydroxychloroquine (HCQ), 20 countries for paracetamol and about 96 countries for vaccines across the world

1.2 Major Credentials of Pharma Industry

• India provides generic medicines to more than 200 countries

• 8 out of 20 Global Generic companies are from India

• Over 55% Exports to Highly Regulated Markets

• 90% of WHO Pre-Qualified APIs are sourced from India

• 65-70% of WHO’s vaccine requirements are sourced from India

• No. of USFDA approved sites: 741 (as of August 2021)

• No. of ANDA Market Authorizations secured by Indian companies: 4,346 (as on December 2020)

1.3 Foreign Direct Investment (FDI)

Pharmaceutical is one of the top ten attractive sectors for foreign investment in India. 100% foreign investment is allowed under automatic route in Medical Devices. Foreign investments in pharmaceuticals in greenfield projects are allowed up to 100% under the automatic route and for brownfield pharmaceutical projects, foreign investment beyond 74% to up to 100%, Government approval is required.

The Department of Pharmaceuticals has approved 10 FDI proposals worth ₹ 7,860 crore inflows under the brownfield pharmaceutical projects during the financial year 2021-22 (till December 2021). The FDI inflows in pharmaceutical sector (pharmaceuticals and medical devices activities) in the last three years under both the routes, government and automatic are as follows:

2019-2020: 3650 crores

2020-2021: 11015 crores

2021-2022: 4143 crores

1.4 Diabetes Market in India

1.4.1 Prevalence of Diabetes in India

The prevalence of diabetes and impaired glucose tolerance has been estimated to be 9.3% and 24.5%,respectively based on the nationally representative sample of adults aged 18–69-years in the NationalNCD Monitoring Survey.

This survey reports that the prevalence of DM was two times higher in urban areas (14.3%) than in rural areas (6.9%).

The ICMR-INDIAB study reported the prevalence of diabetes in urban areas being higher than rural areas, being highest in the age group of 55–64 years (Urban: nearly 25% and rural areas: nearly 10%). Urban predominance of diabetes is an influence of a multitude of factors like rapid urbanization, the prevalence of overweight and obesity in consequence of inactive lifestyle and changing dietary habits. But the proportions in rural areas are also worrisome, with an equally high prevalence of IFG and raised FBG, reflecting the expanding urbanization.

he International Diabetes Federation reported, 67.0% of adults living with diabetes across the world were urban residents, but also notified the rising prevalence of DM in the rural areas (10.8%–Urban vs. 7.2%–Rural). Thus, the emerging challenges with DM in rural India cannot be overlooked, rapid mechanisms are needed to prevent and halt the rise.

The prevalence of IFG was higher than diabetes, specifically most affected were aged 50–69 years, followed by those aged 30–49 years and 18–29 years which constitute to be the most productive years of life. The World Health Organization–IDF reported the 35–64-year age group to be the most prevalent group with diabetes in the developing countries compared to the 65+ years group in the developed countries

The current study showed, the prevalence of IFG and DM being pre-dominant among women. This could be influenced by the sex-related differences in lifestyle and risk factors. Women are more

likely to be with higher BMI (obese or overweight) than men and thus be expected to have a higher prevalence of DM

Table 1: Prevalence of Diabetes in India

Years	People with diabetes in India (in 1000s)
2000	32674.4
2011	61258.4
2021	74194.4
2030	92973.7
2045	124874.7

1.4.2 Incidence of Diabetes in India

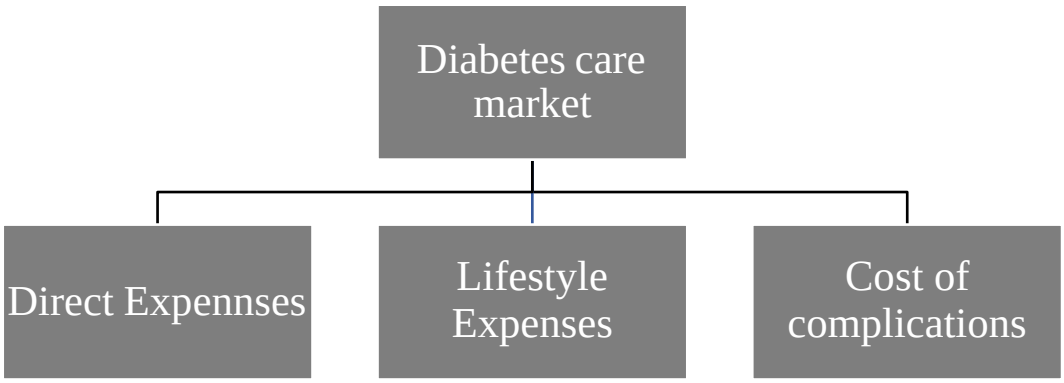
In the Chennai Urban Population Study cohort, diabetes and prediabetes incidence rates were reported to be **20.2 and 13.1 per 1000 person-years**, respectively, while the follow-up study conducted in the Chennai Urban Rural Epidemiology Study (CURES) cohort reported the incidence rates of **diabetes, prediabetes, and any dysglycemia to be 22.2, 29.5, and 51.7 per 1000 person-years, respectively**. The conversion rate to diabetes was reported to be 19.4% among those with normal glucose tolerance and 58.9% among those with prediabetes. Diabetes incidence was reported to be 78.9 per 1000 person-years among those with prediabetes. According to IDF 39.3 mn people are still undiagnosed with diabetes which accounts for 53% of the patient population

Key Growth drivers of Diabetes in India

1. The rising urbanization, govt awareness initiatives and increasing digitization have led to growing Healthcare awareness in India
2. Rise in per capita income, along with increasing insurance coverage has made healthcare more accessible
3. Lifestyle diseases have clearly increased over the last few years in India, further driving the demand for good quality healthcare.
4. There has been consistent push from the Indian government in the past few years through Ayushman Bharat, Central Government Health Scheme to improve the healthcare quality and access

1.4.3 Diabetes Care Market in India

Diabetes care market is 17bn in size and is expected to grow 3.5X in upcoming 10 years. India is home to 75mn Diabetes patients in the world and another 200mn are at high risk (Prediabetes). India follows China to be second largest country in terms of diabetic patients in the world and contributes around 15% of world's total Diabetic population. Indian Diabetes care market in India is 17Bnin size as of FY21and is expected to grow to 59Bn by FY31. There are 3 components of Diabetic care market in India



Direct Expenses: Represents 65% of the expense which includes drugs, monitoring, consultation,diagnostics and outpatient management of complications

Lifestyle expenses: Represents 30% of the total expense and it includes healthy dietary substitutes

Cost of complication: Remaining 5% represents in patient care. Share of heart disease is highest.

1.4.3.1. Diabetes Lifetime Value

- Average Indian spends 11K annually on type 2 Diabetes care and INR 3.5 lakhs in lifetime.
- It costs INR 6K annually for an average Indian who is detected with type 2 diabetes in early 30s of his life
- This cost increases exponentially to INR 17K by the time they reach 60yrs of age

1.4.3.2 Expenditure on Diabetes

Table 1.1 Expenditure on Diabetes by Government

Year	Expenditure (in million USD)
2021	8485.8
2030	10305.5
2045	12834.3

1.4.3.3 Expenditure on Diabetes per person in USD

Table 1.2 Expenditure on Diabetes by the Patient

Year	Expenditure (USD)
2011	68
2021	114.4
2030	138.9
2045	173

On Average a diabetic person spends 11K annually on diabetes care of which 55% of this is towards drugs.

1.4.3.4 Overall spending of 11K is as follows

Table 1.3 Split of expenditure on Diabetes per person

Expenses	% Of 11k	Amount in rupees
Expense on complication	6%	660

Lifestyle expense	13%	1430
Indirect cost	28%	3080
Cost of Drugs	53%	5830

1.4.3.5 Expenditure on Diabetes on the basis of Income groups

Here the patients are divided into various categories on the basis of their monthly household income groups

Category 1: 80K and above

Category 2: 80K-60K

Category 3: 60K-40K

Category 4: 40K-20K

Category 5: Below 20K

Table 1.4 Expenditure on Diabetes by different Income Groups

Expenses	Category 1	Category 2	Category 3	Category 4	Category 5
Spending per month (INR)	7200	3600	1100	360	240
Share of Diabetic Population	5%	7%	13%	40%	35%

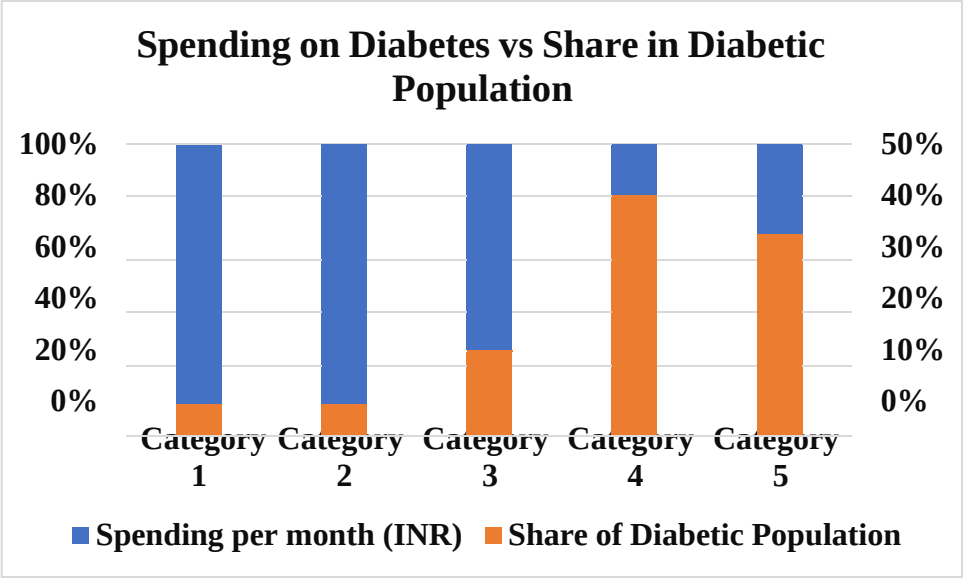


Fig1.1: Spending on Diabetes vs Share in Diabetic Population

1.4.3.5 Expenses on Diabetes on the basis of age

Table 1.5 Expenditure on Diabetes by Age

Expenses	Age 30	Age 40	Age 50	Age 60
Expense on complication	0%	0%	10%	20%
Lifestyle expense	0%	10%	10%	10%

Monitoring and Consultation	15%	25%	20%	18%
Insulin	0%		14%	18%
Drugs	85%	65%	46%	35%
Total cost	6K per annum	9K per annum	12k per annum	17K per annum

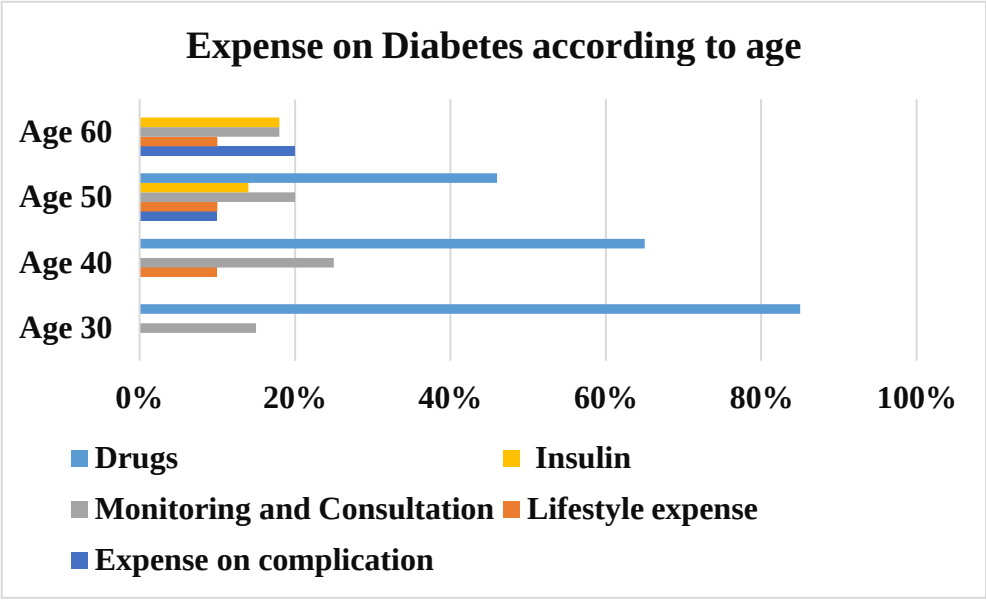


Fig. 1.2: Expense on Diabetes according to age

1.4.3.6 Customer Lifetime Value in case of Diabetes

An average Indian customer spends about 3.5 lakhs in their entire life for diabetes treatment and related care

Table 1.6 Lifetime value of different Income group Diabetes patients

Category	Average lifetime value (in Lakhs)
Category 1	30
Category 2	15
Category 3	4.5
Category 4	1.5
Category 5	1

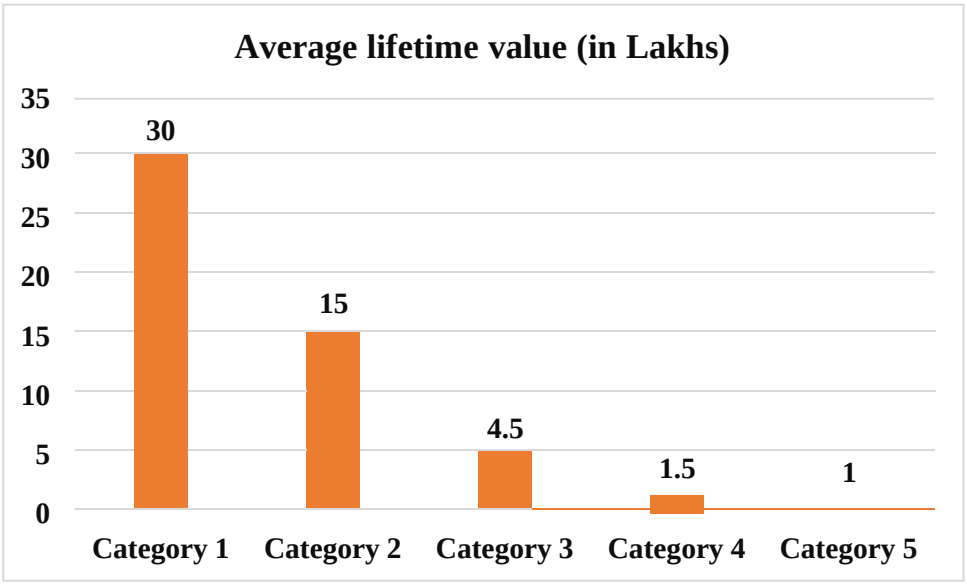


Fig 1.3: Average Lifetime value of Diabetes Patient

1.4.3.7 Platforms to cater the needs of Diabetic Patients

Table 1.7 Diabetes care platforms

Diabetic care needs	Services	Prominent Players
Consultation	• Online consultation via app • Daily health coach • Diet/Nutrition coach and support • AI based health bot chat	Mfine, wellby, Practo, BeatO, twin
Monitoring Devices	• Smart Continuous monitoring devices • Glucometers and test strips • App based analytics and insights	ACCUSure, Roche, Dr Trust, BeatO
Drugs and other care	• Online drug order and home delivery	Pharmeasy, 1mg, Apollo Pharmacy, BeatO
Diagnostic care	• AI home testing • Online test booking	Thyrocare, Dr Lal Path Labs, Zyla, BeatO
Health Food	• Health meal service plans • Diabetes food and snacks	NutriMeal, happyGrub, BeatO
Insurance	• Covering cost of treatment, Hospitalisation • Diabetes related cost	Aditya Birla capital, Star Health Insurance, HDFC Ergo, ICICI Prudential

1.4.4 Health Insurance Companies in Diabetes segment

India has seen the emergence of Insurance solutions specific to diabetes in recent years but they charge a higher price premium of 2-2.5X

Table 1.8 Diabetes care Health Insurance

Provider	Plan Name	Age Limit	Coverage	Waiting period	coverage			
					OPD	Insulin	Drug	Surgery
Star Health	Diabetes Safe	18-65 years	3-10 lakh	2-4 years	✓	✓	✓	✓
National Insurance	Varishta Mediclaim	60-80 years	1-2 lakh additional critical illness core	1 year	✓	✗	✓	✓
Care Health Insurance	Care Freedom	18 to maximum life	5lakh	2 years	✓	✓	✓	✓
ICICI Prudential	Diabetes care	25-60 years	3-5 lakh and maximum up to 10 lakhs	1year	✓	✓	✓	✓
Aditya Birla	Activ Health	Minimum 3 months	2-20 lakh	30 days	✓	✓	✓	✓

	Platinum Enhanced							
HDFC Ergo	Energy Silver	18-65 years	2-25 lakh	0 waiting	✓	✓	✓	✓

1.4.5 Diabetes Reversal

Significant long-term improvement in insulin sensitivity in people with type 2 diabetes with hb1AC below 42mmol/mol without taking diabetes medication for at least 3 month is said as reversed diabetes

Table 1.9 Diabetes Reversal Programs

Services offered	Twin	Sugar.Fit	BeatO	Fitterfly	Freedom from Diabetes
Continuous glucose monitoring and app-based insights	✓	✓	✓	✓	×
Diet tracking and adaptive plan	✓	✓	✓	✓	✓
Live Fitness – online classes		✓		×	×
Peer support to keep the program engaging	×	×	×	✓	×
Goal tracking and personalised intervention	✓	✓	✓	✓	×
Biomarker data tracking (vital tracking)	✓	✓	✓	✓	×
Personal Health coach	✓	✓	✓	✓	✓
On Demand doctor consultation	✓	✓	✓	✓	×
Curated program for pre diabetes patients	✓	✓	✓	✓	×
Curated program for type 2 diabetes patients	✓	✓	✓	✓	✓

1.5 Indian Pharmaceutical Antidiabetic Industry:

It consists of Pharmaceutical Companies both Domestic and MNCs.

1.5.1 Table 1.10 Top 5 Brands in the Anti-Diabetic Segment

Brand	Company	Annual Sales (Cr)	Growth %
Mixtard	Abbott	841.3	1.7
Glycomet -Gp	USV	677.2	11.2
Lantus	Sanofi	641.9	6.0
Novomix	Abbott	451.9	2.5
Janumet	MSD	424.6	-5.2

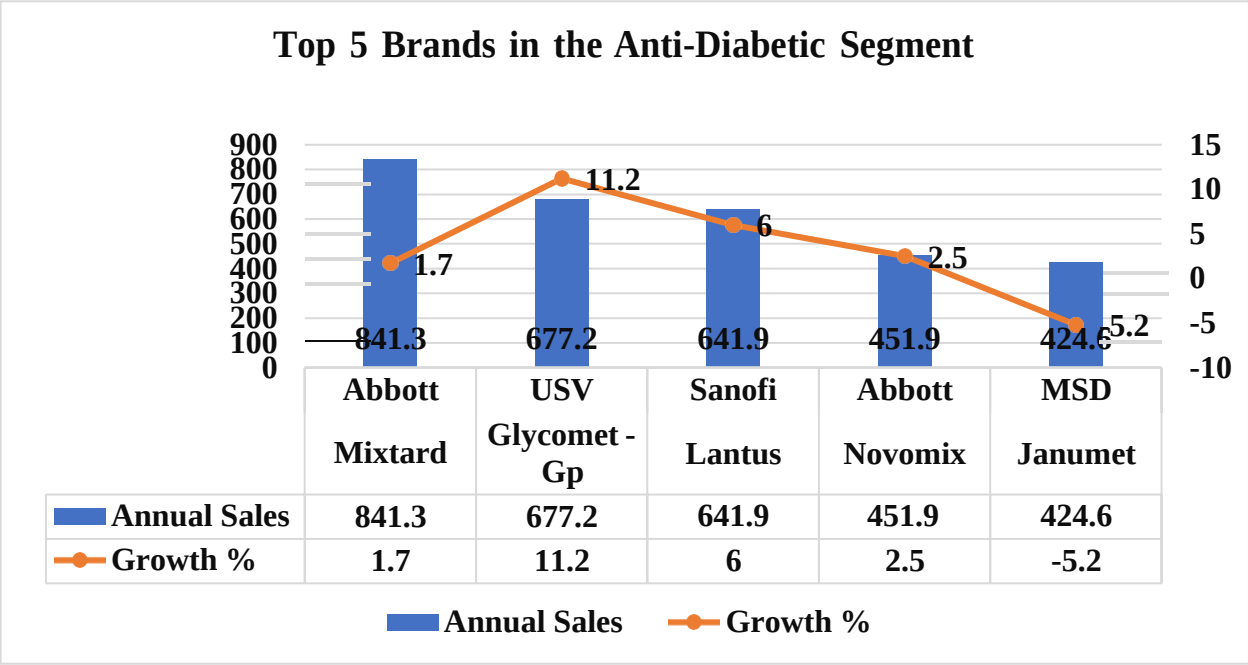


Fig1. 4: Top 5 Anti-Diabetic Brands

1.5.2 Table 1.11 Top 3 molecules in the Anti Diabetes Segment

Molecule	Annual Sales (Cr)	Growth%
Glimepiride+Metformin	2963.5	6.3
Glimepiride+Metformin+Voglibose	1063.6	10.8
Metformin+Vildagliptin	894.2	16.7

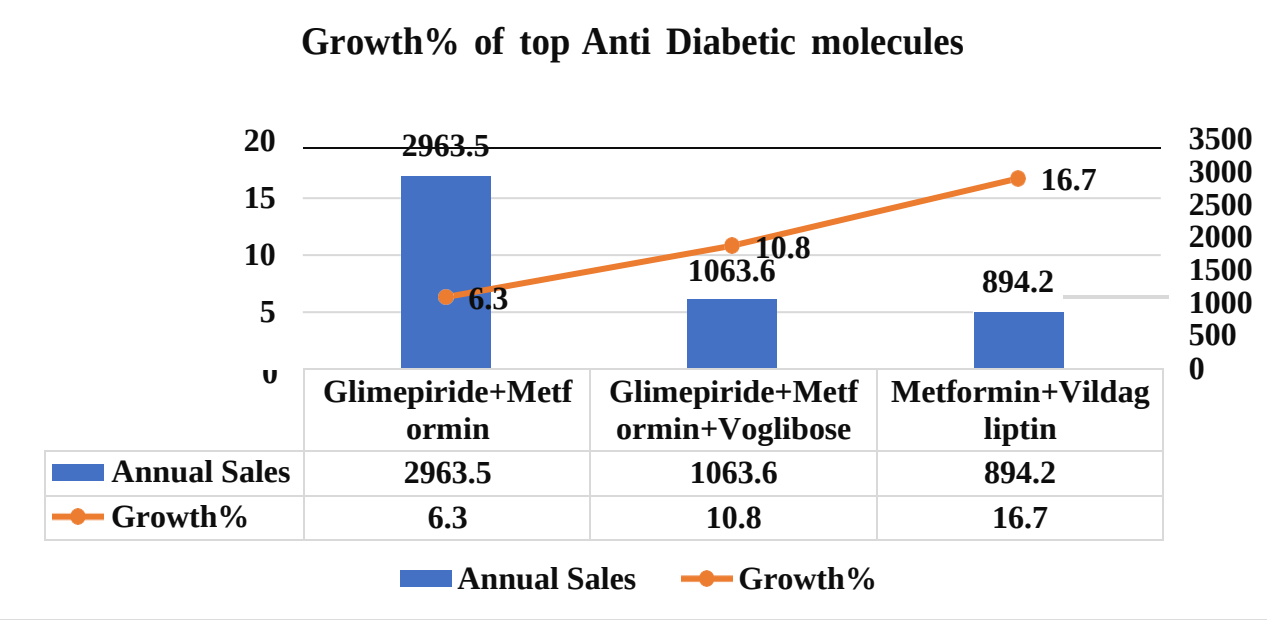


Fig1.5: Top 3 Anti-Diabetic Molecules

1.5.3 Table 1.12 Top Pharmaceutical Companies and their Anti- Diabetic Brands

Company	Brand	Sales (Cr)	Growth %
Boehringer Ingelheim	Jardiance	233.8	-8.2
	Trajenta	146.3	-10.2
	Glyxambi	141.8	35
	Trajenta Duo	74.7	-4.0
	Jardiance Met	64.8	22.7
Abbott	Mixtard	842.4	0.7
	Novomix	476.5	11.3
	Ryzodeg	338.7	37.6
	Novo Rapid	235.5	5.4
Sanofi	Lantus	629.7	0.8
	Amaryl M	162.6	-0.9
Astrazeneca	Forxiga	128.8	14
	Xigduo	36.3	-25.9
MSD	Janumet	420.7	-6.7
	Januvia	147.3	-12.7
	Janumet xr	20.2	-3.6
USV	Glycomet Gp	681	10
	Jalra M	197.8	0.7
	Glycomet Trio	196.1	9.5
	Glycomet	171.2	-0.8
	Jalra	87.4	13
Sun Pharmaceuticals	Gemer	289.9	11.5
	Istamet	238.4	0.4
	Oxra	55.6	-41.3
	Oxramet	40.5	-11.8
Lupin	Gluconorm G	291.8	6
	Huminsulin	207.4	3.8
	Ondero	122.4	4.1
	Ondero met	84	1.5
	Gibtulio	114.3	-14.3
	Ajaduo	108.2	20.2

Micro Labs	Diapride M	68.7	-14.8
	Tripride	58.9	-1.0
	Tenepride M	38.5	3.1
INTAS Pharma	Zoryl M	209.1	3.9

Table 1.13 MRP of top Dapagliflozin Brands in India

Brand Name	**Manufacturer**	**MRP**
Farxiga	Astrazeneca Pharma India Ltd	₹802.90
Gledepa	Abbot	₹802.90
Dapaglyn	Zydus Healthcare Ltd	₹255.00
Oxra	Sun Pharma	₹802.90
Ezydapa	Edoc Life Sciences	₹199.00

CHAPTER 2

LITERATURE REVIEW

2. LITERATURE REVIEW

1. Pradeepa, Rajendra; Mohan, Viswanathan, "Epidemiology of type 2 diabetes in India", Indian Journal of Ophthalmology: November 2021 - Volume 69 - Issue 11 - p 2932-2938

This article focuses on the epidemiology of diabetes in India and the reasons for increasing burden of diabetes in the developing market. The estimates in 2019 showed that 77 million individuals had diabetes in India, which is expected to rise to over 134 million by 2045. Approximately 57% of these individuals remain undiagnosed. Type 2 diabetes, which accounts for majority of the cases, can lead to multiorgan complications, broadly divided into microvascular and macrovascular complications. These complications are a significant cause for increased premature morbidity and mortality among individuals with diabetes, leading to reduced life expectancy and financial and other costs of diabetes leading to profound economic burden on the Indian health care system

In India, the burden of diabetes has been increasing steadily since 1990 and leaps and at a faster pace from the year 2000. The prevalence of diabetes in India has risen from 7.1% in 2009 to 8.9% in 2019. Currently, 25.2 million adults are estimated to have IGT, which is estimated to increase to 35.7 million in the year 2045. India ranks second after China in the global diabetes epidemic with 77 million people with diabetes. Of these, 12.1 million are aged >65 years, which is estimated to increase to 27.5 million in the year 2045. It is also estimated that nearly 57% of adults with diabetes are undiagnosed in India, which is approximately 43.9 million. The mean healthcare expenditure on diabetes per person is 92 US dollars, and total deaths attributable directly to diabetes account for 1 million. According to one report, Tamil Nadu had the highest prevalence in 2016, followed by Kerala, Delhi, Punjab, Goa, and Karnataka. According to study conducted in the Chennai Urban Rural Epidemiology Study (CURES) cohort reported the incidence rates of diabetes, prediabetes, and any dysglycemia to be 22.2, 29.5, and 51.7 per 1000 person-years, respectively. The conversion rate to diabetes was reported to be 19.4% among those with normal glucose tolerance and 58.9% among those with prediabetes. Diabetes incidence was reported to be 78.9 per 1000 person-years among those with prediabetes.

2. Martha K Nicholson, Randa Ghazal Asswad & John PH Wilding, "Dapagliflozin for the treatment of type 2 diabetes mellitus – an update", Expert opinion on Pharmacotherapy, volume 22, 2021 – issue 17

This article focuses on the comparative clinical efficacy of Dapagliflozin against other drugs used in type 2 diabetes. Phase III clinical trials have reported contrasting outcomes regarding urinary tract infections (UTI). This has been a contentious issue, as increased glucosuria from SGLT inhibitors is a plausible mechanism by which they would increase genitourinary infection risk. Pooled data from 12 dapagliflozin clinical efficacy trials in T2DM showed 7.3% and 6.5% of patients receiving 5 and 10 mg of dapagliflozin, respectively, developed UTI symptoms as compared to only 4.5% receiving a placebo; however, infections were commonly mild or moderate and responded well to treatment.

Genital infections including fungal vulvovaginitis and balanitis are more frequently associated with dapagliflozin use. These infections were reported in 4.1–5.7% of patients, as compared to a 0.9% infection rate on placebo, in a pooled study of 4545 patients. The DECLARE study supported this finding, with genital infections again more common with dapagliflozin compared to placebo. Overall, these infections were also easily treated and rarely led to drug or study discontinuation.

Due to SGLT2 inhibitors mechanism of action being independent of insulin, the risk of hypoglycaemia is believed to be marginal. No significant increase in hypoglycemia risk is present in patients receiving dapagliflozin as monotherapy or as an adjunct to treatments, such as metformin, sitagliptin, pioglitazone, or insulin. Extra caution may be required when added to medication of the sulfonylurea class; as an add-on to glimepiride, 10 mg of daily dapagliflozin increased the frequency of hypoglycaemic episodes by 3.1% from a baseline of 4.8%.

Considering the cardiovascular benefits, dapagliflozin demonstrated greater protection against HF as compared to less dramatic effects on secondary outcomes such as MACE. Similarly, DAPA-HF and DAPA-CKD have provided evidence that dapagliflozin has both cardio and Reno protective effects, and may reduce the risk of all-cause death in patients with HF or impaired renal function.

Research developments relating to SGLT2 inhibitors have been very promising in recent years. Dapagliflozin use has been shown to be both safe and effective in both patients with T2DM and T1DM, with the drug now also licensed for use as an adjuvant to insulin. It is estimated that seven million acute MIs occur worldwide every single year, with HF as a complication associated with poorer hospital survival

Dapagliflozin could potentially have beneficial effects on other macro and microvascular complications of T2DM, such as non-alcoholic fatty liver disease (NAFLD) and diabetic neuropathy due to its lowering effects on blood glucose, as well as some of the mechanisms posited for renal and cardiac protection

3. Rajiv Singla, Jatin Bindra, Ankush Singla, Yashdeep Gupta, Sanjay Kalra "Drug Prescription Patterns and Cost Analysis of Diabetes Therapy in India: Audit of an Endocrine Practice", January 2019

The study aims to analyse the current trend in the use of antidiabetic as well as other drugs for comorbidities along the duration of diabetes along with analysis of the direct drug cost to patients. In India, the amount spent by the government on health is relatively less when compared to Western and European countries. Few notable points regarding health economics of diabetes in India are first, private healthcare is the predominant provider of diabetes care in India with government setups providing only around 20% of care; second, expenditure done on diabetes care is largely out- of-pocket expense and contributes to catastrophic health expenditure (defined as household health spending exceeding 10% of household consumption expenditure) in 45% of patients; third, 23% meet this expenditure by borrowing from banks and money lenders, also known as distress financing. Situation is little better in higher socioeconomic strata.

The percentage of patients on metformin remains steady over the duration of diabetes from 0 to 20+ years. The percentage of sulfonylurea and dipeptidyl peptidase-4 inhibitors (DPP4i) increases from 23.12% and 22.5%, respectively, in 0–5 years of duration of diabetes to 70.77% and 60%, respectively, in 10–15 years of diabetes. Thereafter, the percentage of sulfonylurea and DPP4i becomes steady. And as prescription of sulfonylureas and DPP4i starts plateauing, prescription of insulin and sodium/glucose cotransporter 2 inhibitors starts rising. The percentage of alpha glucosidase inhibitors has a slight growth from 5 to 10 years of duration of diabetes to 20+ years of duration of diabetes. In the current practice and in the given set of patients, thiazolidinediones and glucagon-like peptide-1 receptors agonists share negligible percentage. Insulin requirement at 46% after 20 years may seem lower than previous estimates. Analysis of antidiabetic drug classes in people with diabetes according to their age and BMI, revealed a decrease in the usage of SGLT2 inhibitors in older age group, whereas the remaining of the drugs had no correlation with age. As

BMI increases, there is a decrease in the usage of sulfonylureas, whereas there is an increase in the usage of SGLT2 inhibitors consistent with international guidelines

Cost of Diabetes in India (CODI) study outlined that antidiabetic drug cost accounts only for 17% of direct medical expenses on diabetes care. Although a few other studies estimate it at much higher proportion to 30%–50% of direct costs. A large proportion is spent on hospitalization (35%), followed by investigations (22%), consultations (12%), and other drugs (11%). The author compares this study with a study published in 2007 from the same geographical area, reveals a sharp increase in the cost of diabetes care. The mean cost of antidiabetic therapy increased from INR 5.44 to 7.25 per da International Journal of Clinical Endocrinology and Metabolism y in people with less than 5 years of diabetes, from INR 9.5 per day to 24.23 with the duration of diabetes between 5 and 10 years, from INR 12.69 to 52.12 with 10–15 years' duration of diabetes, and from INR 17.50 to 63–78 among people with more than 15 years of diabetes. The cost of therapy increased with complications, use of insulin, hospitalization, and availing private healthcare

4. Kakade Ashutosh, Ray Mohanty Ipseeta and Rai Sandeep, "Assessment of Prescription Pattern of Antidiabetic Drugs in the Outpatient, Department of a Tertiary Care Hospital", International Journal of Clinical Endocrinology and Metabolism, March 17, 2017

This Article aims to study the prescription pattern of the doctors while prescribing medication for type 2 diabetes. It focuses on the type of therapy chose by doctor on the basis of various patient factors. 220 patients participated in the present study. Majority of the respondents (36.8%) belonged to the age group of below 50 years followed by age group above 60 year (32.3%). In the present study the male to female ratio was found to be 1.34 {male patients (57.3%) and female patients (42.7%)}.

In the study majority of the patients belonged to the upper middle socio-economic class. Most of the diabetic patients (92.3%) were on Oral Hypoglycaemic Agents only and 7.7% were on Insulin and oral hypoglycaemic agent (OHA) combination therapy. Result demonstrated that the average number of drugs encountered per prescription was found to be 2.03. Drugs prescribed from national essential drug list were 61.74%. In the present study no drug was prescribed by generic name. All were prescribed by brand names. In the present study, it was found that 30% of patients were on monotherapy with oral hypoglycaemic agent compared to 70% on combination therapy.

In a study conducted in Tamil Nadu, monotherapy, and two drug combination therapies were prescribed in 21.7% and 78.3% patients, respectively. The most commonly prescribed anti-diabetic drug class was biguanides (Metformin) both as monotherapy and/or in combination therapy, Metformin accounted for (85%) of the total drugs prescribed, followed by sulfonylureas (Glimepiride), (41%) and then DPP4 inhibitors (Teneligliptin, Vildagliptin). Unlike sulfonylureas, thiazolidinediones, and insulin, metformin is weight neutral, which makes it an attractive choice for obese patients. Furthermore, the management of Type II diabetes can be complicated by hypoglycaemia, which can seriously limit the pursuit of glycaemic control. By decreasing excess hepatic gluconeogenesis without raising insulin levels, metformin rarely leads to significant hypoglycaemia when used as a monotherapy. As a result, metformin is widely considered an ideal first-line agent for the treatment of Type 2 diabetes. In addition, the cost of metformin is very low, thus making it affordable by the patients in economically weak countries like India.

Interestingly results did not concur with the usage pattern of DPP4 inhibitors. The potential benefits of DPP-4 inhibitors include their complementary mechanism of action with other antidiabetic medications, a favourable adverse-effect profile, and a neutral effect on weight. With a low risk of

hypoglycaemia, DPP-4 Inhibitors are advantageous for patients who are close to their target HbA1c but who continually experience elevated glucose levels after meals. The most commonly prescribed fixed dose combination among two drug combination was found to be Metformin + Vildagliptin (37%) followed by Metformin + Glimepiride (34%). Among three drug combination Biguanide, sulfonylureas+ Alfa glucosidase inhibitor were most frequently prescribed fixed dose combination. Metformin was the most frequently prescribed drug in diabetes followed by sulfonylureas (Glimepiride). Metformin with glimepiride was the most frequently prescribed combination therapy. Among Fixed drug combination, prescription of Metformin + Vildagliptin was the most common. Majority of drugs were prescribed from national essential drug list. Average number of drugs per prescription was found to be 2.03

5. Sharma E. Kumar, "Diabetes Drug Dapagliflozin Needs to Brace for Price War, Analysts Say", Science:The Wire, October7, 2020

In this article the analyst covers both the legal and market angle of dapagliflozin in Indian Pharmaceutical market. It covers issues such as launch of generic dapagliflozin under the brand name "Dapaglyn". Zydus has said Dapagliflozin will be available at a third of the price. This translates to Rs 17 for a 10-mg pill and Rs 14 for a 5-mg pill. A day later, Eris Lifesciences, another Ahmedabad-based company, also launched the drug with its own 10-mg variant priced at Rs 14.50 a tablet, and a 5-mg tablet for Rs 14. Other companies are also in the process of launching their Dapagliflozin variants, with some even attempting to price each pill at Rs 12 or lower. The market for Dapagliflozin drugs growing at 20% per annum in India and the challenge at the moment is that the drug apparently has two patent registrations in India — IN 205147, which is the 'genus patent' up to October 2, 2020, and IN 235625, the 'species patent' valid up to May 15, 2023. Since April 2020, AstraZeneca has taken several companies to the Delhi high court alleging patent infringement, and hearings are underway.

According to AIOCD AWACS, the market for anti-diabetes medicines is a huge and growing market. It today stands at around Rs 14,000 crore (in terms of retail sales of anti-diabetes medicines in India in a year) and is growing at around 8% per annum. Within this, the market for dapagliflozin alone is today at around Rs 360 crore (this includes dapagliflozin tablets and tablets that have dapagliflozin in combination with other medicines such as metformin) and growing at a whopping 29% per annum.

6. Bhavani Shankara Bagepally, Usa Chaikledkaew, Sitaporn Youngkong, Thunyarat Anothaisintawee, Montarat Thavorncharoensap, Charungthai Dejthevaporn and Ammarin Thakkinstian, "**Cost-Utility Analysis of Dapagliflozin Compared to Sulfonylureas for Type 2 Diabetes as Second-Line Treatment in Indian Healthcare Payer's Perspective", ClinicoEconomics and outcome research, October22,2021**

This article aims to evaluate the long-term cost-effectiveness of dapagliflozin (sodium glucose transporter 2 inhibitor) compared to commonly used sulfonylureas as second-line drugs in Indian patients with T2DM. The total costs, LYs, and QALYs of second-line therapy were ₹292,416 ($3,915), 158.66 LYs, and 69.64 QALYs for sulfonylureas and ₹475,048 ($6,361), 162.16 LYs, and 71.36 QALYs for dapagliflozin.

Compared to sulfonylureas, dapagliflozin therapy incurred an additional cost of ₹1,82,632 ($2,445), with an additional 3.49 LYs or 1.72 QALYs, resulting in an ICER of ₹52,270 ($699) per LY gained, or ₹1,06,133 ($1,421) per QALY gained. The utmost sensitive parameters to influence the ICER values were transitional probabilities of metformin treatment failure, dual therapy failure, and cost of triple therapy. The cost of triple therapy had the highest influence on the ICER change (36.8%).

This article highlighted the value given to the patient on the therapy switch and comparative value provided by different molecules and therapies like Monotherapy, Dual therapy and Triple therapy and lets the doctor choose the best therapy on the basis of patient's economic situation. To conclude Dapagliflozin would be cost-effective compared to sulfonylureas as the second line added to metformin for T2DM patients based on an Indian payer's perspective.

7. Pritam Ghosh, Aparajita Dasgupta, Bobby Paul, Soumit Roy, Sauryadripta Ghose, Akanksha Yadav, "Out-of-pocket expenditure for diabetes mellitus and its determinants in recent times in India: A narrative review", Journal of Diabetology, Volume 12, Page 416-423

This article aims to study review and summarize cost burden of diabetes and its determinants from existing literature in the last 10 years in India. The findings clearly indicate that the hospitalization cost in India due to diabetes complication varies greatly from region to region from being 3400 in the economically backward region to 12000 in metro cities. Also, the total expenses (Direct expense + Indirect Expense) vary from 5000 to 34000 per person in India. Medicine cost and wage loss account for 90% and 67% of the total indirect cost for a diabetic person. A multicentric study reported that 0.7% of households in high-income countries and 26.9% of households in low-income countries could not afford metformin. Initiatives to strengthen health systems are essential in this situation. Government of India already launched Pradhan Mantri Bhartiya Janaushadhi Pariyojana to provide generic drugs, which are available at lesser prices but are equivalent in efficacy as expensive branded drugs. Moreover, insulin therapy significantly made the patient susceptible for high OOP expenditure.

Substantial amount of indirect cost (mainly *wage loss* for health care seeking or ill-health) was found. This high indirect cost indicated productivity loss of working population. It can affect in long term on country's economy when people will start to get the disease at earlier age.

Longer duration of disease was seen as a significant factor for higher cost. It meant that either higher age or early onset of diabetes had impact on expenditure. Reason behind it might be that longer duration would arise complications, requirement of excess drugs, and investigation. Complications of diabetes vary from mild to severe forms. Severe forms of complication require extra care on hospital admission. Thus, complications increased expenditure. Lower expenditure among the low-income group may be due to poor access and affordability, but greater portion of their income was spent in treatment when compared with the high-income group. Late detection of the disease in the vulnerable population often leads to early complication and subsequently "catastrophe" in household expenses. It also pointed out absence of equity in health care, particularly in modern epidemic like diabetes. Allocation of resources in public health infrastructure is need of the hour so that poorer section can depend on government sector for their regular ambulatory care to avoid "catastrophe."

Health seeking behaviour had also significant influence on health expenditure. Patients who sought private facilities had reported more direct costs compared with those in government hospital. In government hospital and health centres, patients get free medicines and access to diagnostic procedures. But patients in the private sector have to procure medicines and purchase lot of money for various investigations. Thus, the private sector expense clearly surpasses that of the government sector.

8. Jothydev Kesavadev, Gopika Krishnan, Viswanathan Mohan, "Digital health and diabetes: experience from India", Therapeutic Advances in Endocrinology and Metabolism, Sage Journals, November 17, 2021

In this article the authors have given special emphasis to digital aspects of health with special reference to diabetes. Continuous glucose monitoring systems (CGMs) are a very good example of the absorption of digital technology in healthcare. CGMs allow the measurement of glycemic variability (GV) to monitor glucose trends in PwD. India was the first country to receive approval for FreeStyle® Libre Pro Flash Glucose Monitoring System in 2015. In 2020, FreeStyle® Libre, the isCGM (intermittently scanned CGM), was launched in India. Despite the Covid pandemic, it was widely accepted by the physician and patient communities. The COVID pandemic prompted the Government of India to promote digitalization of the healthcare sector in various aspects such as e-consultations, health surveillance, health education, and other healthcare services. During the lockdown, the country witnessed a large number of patients with T2D seeking online support through YouTube, Facebook, WhatsApp, and Google search for diabetes management. The platform/media used for obtaining information included videos on disease management, Apps, blogs, voice/video call facilities, short message services (SMS), and TV channels.

Coming to developments in the diabetes sector Sanofi's My Dose Coach Mobile App has an in-built insulin dose calculator for patients with T2D to self-titrate basal insulin via automated dosing suggestions. MyStar Plus (Sanofi) app helps in diabetes management by displaying all the diabetes-related data to facilitate precise and prompt clinical decisions. mySugr App (Roche) supports PwD in diabetes management by synchronizing with Accu-Chek blood glucose meter and transmitting the data to Apple and Android devices. The Author believes that the slow but steady progress toward the digitalization of diabetes care has been the innovation of this decade. Emerging technologies such as real-time continuous glucose monitoring, automated insulin delivery systems, EMRs, m-Health, and telemedicine are steadily picking up in the country

9. GunjeetKaur, Akashdeep SinghChauhan, Shankar Prinja, "Cost-effectiveness of population-based screening for diabetes and hypertension in India: an economic modelling study" Lancet Public Health, Volume 7, Issue 1, January 2022

This Article draws a correlation between effective diagnosis of diabetes and hypertension and cost reduction and proper management for diabetic patients in India through government schemes. The Government of India's Ayushman Bharat Health and Wellness Centre programme aims to expand primary care for diabetes and hypertension through the transformation of 150 000 subcentres and primary health centres to HWCs. As of 2016 (the latest available data), 3·8% of patients with diabetes or hypertension access care at subcentres and primary health care levels. Authors' analysis also showed that shifting the provision of primary care for patients with diabetes or hypertension to HWCs could make population-based screening cost-effective. An increase in HWC share for provision of primary care for patients with diabetes or hypertension to 70%, from the existing 3·8% at subcentres and primary health centres, makes an annual population-based screening a cost saving strategy.
At present, few studies have estimated the cost-effectiveness of population-based screening for diabetes or hypertension. Authors' findings indicated that screening annually, every 3 years, and every 5 years led to an earlier detection of diabetes and hypertension compared with current practice. They found a 12% reduction in the incidence of complications for both diabetes and hypertension with annual screening. However, this risk reduction was found to be higher for microvascular rather than macrovascular complications, as noted in other epidemiological and economic analyses. At the population level, they found a gain of 0·05 life-years per person with annual screening, which was higher than that reported in another study in which one-off screening for diabetes or hypertension

was evaluated. In an evaluation for facility-based screening for diabetes or hypertension, a gain of 0·17 QALYs was reported for every 3year screening at age 30 years

10. Lam D, Sheikh A "Real Life Prescribing of SGLT2 inhibitors: How to handle other medications, including glucose lowering drugs and Diuretics" American Society of Nephrology, Kidney 360, April 2021

In this article the author sheds light on screening for conditions that increase risk for adverse effects of SGLT2is. Such conditions include cognitive impairment, advanced age, limited mobility, recurrent urinary tract infections (UTIs), indwelling Foley catheter, neurogenic bladder, poor genital hygiene, solitary kidney, bilateral renal-artery stenosis, immunosuppressive therapy, and history of diabetic ketoacidosis (DKA). Patients with these underlying conditions must be assessed on an individual basis, weighing the risks and benefits of SGLT2i therapy. The safety of SGLT2is have not been established in kidney transplant recipients, or in pregnant or lactating women. Fournier gangrene is a serious medical condition, and it remains unclear whether SGLT2is increase the risk of Fournier gangrene or not; however, it is worth noting that such an association has not been observed in the any of the large SGLT2i clinical trials.

SGLT2is offer cardiorenal protection for patients with and without T2DM. Using a simple strategy for assessing the risks and modifying antihypertensive, diuretic, and antiglycemic agents can mitigate the potential adverse effects of SGLT2is. With the growing evidence for safe use and renal-protective effects of SGLT2is, nephrologists now have a therapeutic agent to combat the pandemic of diabetic kidney disease

CHAPTER 3

NEED FOR THE STUDY, OBJECTIVES OF THE STUDY AND RESEARCH METHODOLGY

3.1 PROBLEM STATEMENT

Over the past many years, sense of marketing has changed dramatically. Instead of adopting a product-centred make/create and sell approach, Diabetic care firms have been obliged to adjust themselves to an entirely customer-focused business model, which is more of a read and respond philosophy towards the market. Today, it is a must for businesses and organizations to understand and pay more attention to consumers' value perceptions of products and services than ever to be successful in an unprecedented competitive environment.

Therefore, it is crucial to conduct new and comprehensive researches dealing with the new challenges in the Diabetic care domain, consumers' value perceptions for a deeper understanding which allows creating a high level of customer satisfaction by responding properly to patient demands and expectations. Naturally, when it comes to providing therapy to patients, especially patients having chances of comorbidity diseases, impaired metabolic mechanisms, high cost of treatment- and low customer adherence, which results in less customer satisfaction gain and their significance needs to be understood thoroughly.

3.2 NEED FOR THE STUDY

This study firstly aims to find the market potential and preference of Dapagliflozin over other drugsused in Type 2 Diabetes. Since Diabetes is a chronic disease and the markets for the chronic diseasesare changing rapidly, so it is very important to track necessary changes and study the market potentialof new generation drugs to get a clear picture of the treatment space of the disease

In the second place, it is aimed to investigate to what extent this new drug is getting its place in the prescription of the Diabetologists and how it is serving the customer needs by giving delivering value. The results indicate that it has started making its place in the perception of doctor where the patient has a very long duration of Diabetes or has a very high BMI index. Owing to its cardioprotective nature it is now widely used to supress the cases of myocardial infarction in Diabetes patients.

3.3 OBJECTIVES OF THE STUDY

One of the main objectives of this study is to discuss the perceived value of Dapagliflozin in terms of Increasing DALY in the context of type2 Diabetes, and to investigate to what extent it influences customer satisfaction. So, in the following section, in addition to perceived value and customer satisfaction concepts, especially clinical, non-clinical and market related factors are to be discussed briefly on the base of their importance.

The objective of the study is further divided into-

- firstly, aims to analyse the Clinical and Non-Clinical attributes of Diabetologists and their preferred treatment on the basis of Duration of Diabetes and BMI Index.
- Secondly, it aims to analyse the market related factors like pricing, insurance and Influence of KOLs in determining the market potential of the drug.

3.4 RESEARCH METHODOLOGY

To achieve the research objectives, a structured closed-ended questionnaire was prepared. The questionnaire statements were modified to adapt with treatments in type 2 Diabetes domain, divided under three dimensions, namely (1) Clinical Factors (2) Non-Clinical Factors (3) Market related factors. The questionnaire included 25 statements in all to be marked on a 1–5 point Likert scale and 16 multiple choice questions.

The demographic criteria of the respondents included in the study were geographic region, name of hospital and type of hospital.

Data was collected using online survey (Google forms) and target respondents were Practicing diabetologists and general medicine prescribers. Sample size was 100.

The information gathered for the survey was analysed using SPSS version 24 and excel.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4. DATA ANALYSIS AND INTERPRETATION

4.1 DEMOGRAPHIC ANALYSIS

Demographic analysis involves segregating the respondents into specific groups on the basis of age, gender, qualification, and annual income. The frequencies and percentages of the 100 survey respondents are divided within the individual parameters of type of Hospital and Location of Hospital are presented in the following tables.

Table 4.1 Demographics for Hospitals

Type of Hospital					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government Hospital	84	84.0	84.8	84.8
	Private Hospital	15	15.0	15.2	100.0
	Total	99	99.0	100.0	
Missing	System	1	1.0		
Total		100	100.0		

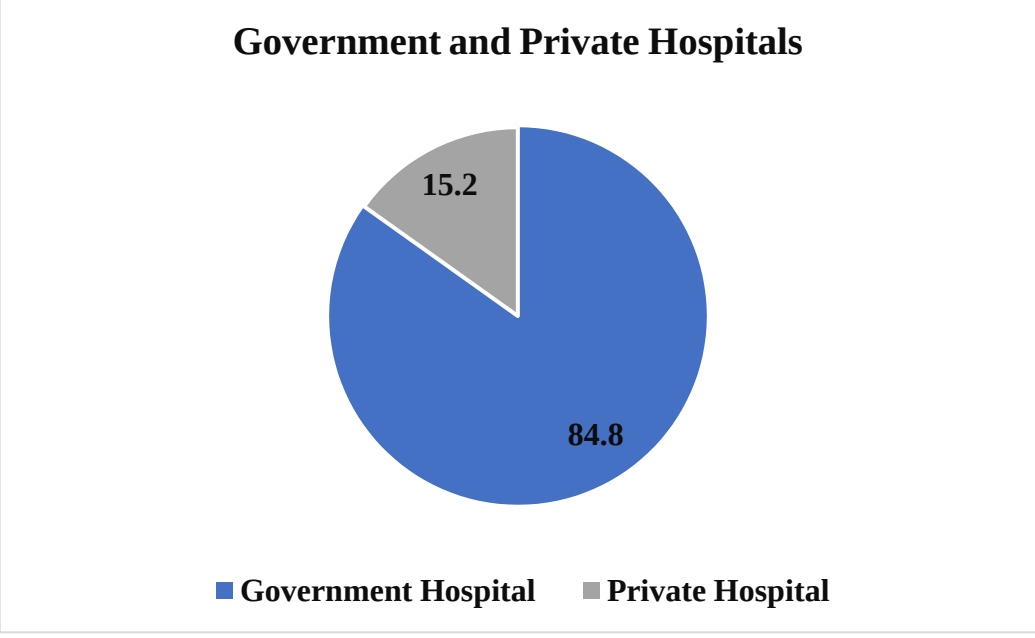


Fig 1.6: Type of Hospitals

Location of Hospital

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	15	15.0	15.2	15.2
	2	1	1.0	1.0	16.2
	3	9	9.0	9.1	25.3
	4	1	1.0	1.0	26.3
	5	2	2.0	2.0	28.3
	6	23	23.0	23.2	51.5
	7	2	2.0	2.0	53.5
	8	23	23.0	23.2	76.8
	9	1	1.0	1.0	77.8
	10	1	1.0	1.0	78.8
	11	4	4.0	4.0	82.8
	12	12	12.0	12.1	94.9
	13	3	3.0	3.0	98.0
	14	2	2.0	2.0	100.0
	Total	99	99.0	100.0	
Missing	System	1	1.0		
Total		100	100.0		

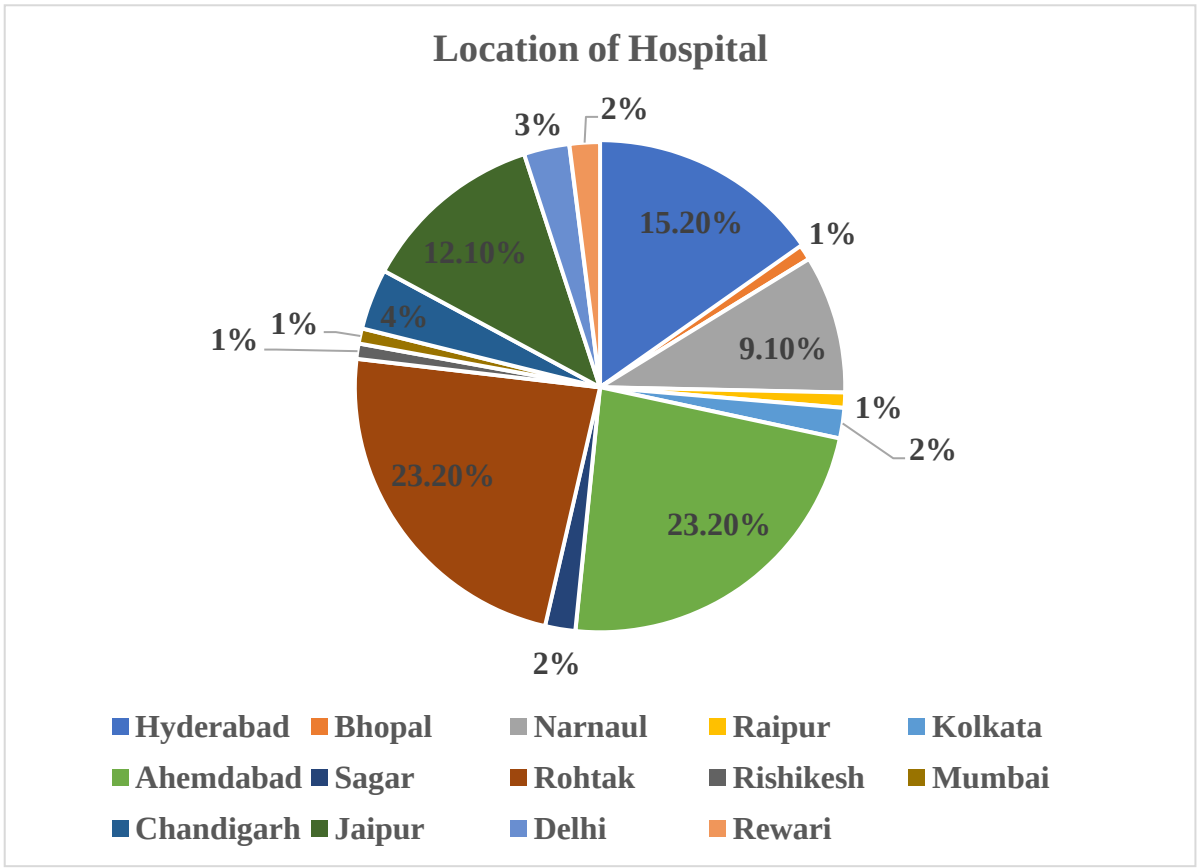


Fig 1.7: Location of Hospitals

So, the demographic analysis revealed that out of 100 respondents –

- 84.8% of respondents worked in a Government Hospital and 15.2% worked in private hospital

- 15% of Respondents were from Hyderabad, 9% were from Narnaul, 23% were from Ahmedabad, 23% were from Rohtak and 12% were from Jaipur

- 15% were from south India, 32% were from North India and 35% of respondents were from western part of India

4.2 RELIABILITY STATISTICS

Reliability refers to the extent to which a scale produces consistent results if repeated measurements are made.

Internal consistency reliability is used to assess the reliability of a summated scale where several items are summed to form a total score. In a scale of this type, each item measures some aspects of the construct measured by the entire scale, and the items should be consistent in what they indicate about the characteristic. This measure of reliability focuses on the internal consistency of the set of items forming the scale.

The internal consistency can be measured by two methods:

1. Split-half reliability

2. Coefficient alpha or Cronbach's alpha

The **Coefficient alpha or Cronbach's alpha,** is the average of all possible split- half coefficients resulting from different ways of splitting the scale items. This coefficient varies from 0 to 1, and a value of 0.6 or less generally indicates an unsatisfactory internal consistency reliability.

All the components of the Clinical, Non-Clinical and Market Factors are measured in the summated scale for developing their constructs. Cronbach's alpha is measured for all the components within the promotional mix, pricing mix, and customer satisfaction to ensure internal consistency. High value of Cronbach's alpha indicates that the components are correlated with each other.

Table 4.3. Cronbach's Alpha for Clinical Factors

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.570	**.976**	**10**

Interpretation: Value for Cronbach's alpha is 0.570 for all the variables of the clinical factors, thusthe scale passes the reliability statistics as the value is greater than 0.5. Hence, it means that the variables within the clinical factors are related with one another.

Table 4.4. Cronbach's Alpha for Non-Clinical factors

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.545	**.976**	**8**

Interpretation: Value for Cronbach's alpha is 0.545 for all the variables of the non-clinical, thus the scale passes the reliability statistics as the value is greater than 0.5. Hence, it means that the variables within the non-clinical factors are related with one another.

Table 4.5. Cronbach's Alpha for Duration of Diabetes and Therapy

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.718	**.976**	**8**

Interpretation: Value for Cronbach's alpha is 0.718 for all the variables of the Duration of Diabetes and Therapy, thus the scale passes the reliability statistics as the value is greater than 0.5. Hence, it means that the variables within the duration of diabetes and preferred therapy are related with one another.

Table 4.6. Cronbach's Alpha for BMI Index and preferred therapy

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.684	**.976**	**8**

Interpretation: Value for Cronbach's alpha is 0.684 for all the variables of the BMI Index and preferred therapy, thus the scale passes the reliability statistics as the value is greater than 0.5. Hence, it means that the variables within BMI Index and preferred therapy are related with one another.

Table 4.7. Cronbach's Alpha for Market Factors

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.591	**.976**	**4**

Interpretation: Value for Cronbach's alpha is 0.591 for all the variables of the Market Factors, thus the scale passes the reliability statistics as the value is greater than 0.5. Hence, it means that the variables within the Market Factors are related with one another.

4.3 INDEPENDENT SAMPLE t-TEST

A 2-tailed independent sample t-test is performed to identify the difference between responses as pergender on statements of sponsorship being the best way to advertise brands. It is applied when we have two independent samples and we want to make a comparison between two groups of individuals. To evaluate the mean difference between two populations, sample means from each population is compared on a given variable.

Null Hypothesis (H_0) – There is no significant relation between the clinical, non-clinical, market factors and type of Hospital

Alternate Hypothesis (H_1) – There is a significant relation between the clinical, non-clinical, market factors and type of Hospital

Table 4.8. Independent t-Test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
CF	Equal variances assumed	.336	.564	.761	97	.448	.44286	.58166	1.59730	.71158
	Equal variances not assumed			.735	18.797	.472	.44286	.60291	1.70568	.81996
NCF	Equal variances assumed	.270	.605	1.194	97	.235	.93571	.78383	2.49140	.61997
	Equal variances not assumed			1.334	21.494	.196	.93571	.70130	2.39210	.52067
MF	Equal variances assumed	.004	.948	1.130	97	.261	.59762	.52886	1.64726	.45202
	Equal variances not assumed			1.238	21.046	.229	.59762	.48273	1.60139	.40615

Interpretation: T value is insignificant as p>0.05 for expression of unmet need. So, for this parameter Null hypothesis is accepted and hence this parameter does not vary significantly with type of hospital.

4.4 ANOVA Testing

Hypothesis concerning the equality of two population means can be tested using independent t-test. However, if there are more than two populations, the test for the equality of means could be carried out by considering two populations at a time. This would be a very cumbersome procedure. One easy way out could be to use the analysis of variance (ANOVA) technique. ANOVA is a general technique

that can be used to test the hypothesis that the means among two or more groups are equal, under the assumption that the sampled populations are normally distributed.

- **ANOVA of Long Duration of Diabetes and BMI Index:**

- **Null Hypothesis (H_0)** – There is no significant relation between use of Dapagliflozin forpatients having long duration of Diabetes and BMI Index of Patient

- **Alternate Hypothesis (H_1) –** There is a significant relation between use of Dapagliflozin for patients having long duration of Diabetes and BMI Index of Patient

Table 4.9. ANOVA Long Duration of Diabetes and BMI Index

ANOVA						
Duration of Diabetes and BMI Index						
ANOVA						
		Sum of Squares	df	Mean Square	F	Sig
3A3	Between Groups	2.593	2	1.296	7.302	0.001
3A4	Within Groups	17.044	96	.178	8.501	0.000

Interpretation: Since computed F value is more than the tabulated F value and $p<0.05$, Alternate hypothesis is accepted and hence this parameter varies with the BMI Index of patients.

- **ANOVA of preference of Dapagliflozin for long duration of Diabetes and Cardiovascular Events:**

- **Null Hypothesis (H_0)** – There is no significant relation between Dapagliflozin for long duration of Diabetes and Doctor and Cardiovascular Events
- **Alternate Hypothesis (H_1) –** There is a significant relation between Dapagliflozin for long duration of Diabetes and Doctor and Cardiovascular Events

Table 4.10. ANOVA Dapagliflozin use for long duration of Diabetes and Cardiovascular Events

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
3A3	Between Groups	1.229	1	1.229	6.475	.013
	Within Groups	18.408	97	.190		
	Total	19.636	98			
3A4	Between Groups	1.081	1	1.081	4.648	.034
	Within Groups	22.556	97	.233		
	Total	23.636	98			

Interpretation: Since computed F value is less than the tabulated F value and p<0.05, Alternate hypothesis is accepted and hence this parameter varies with the cardiovascular events

- **ANOVA of High BMI Index Patients and per day cost of treatment:**

- **Null Hypothesis (H_0)** – There is no significant relation between high BMI Index and per day cost of treatment

- **Alternate Hypothesis (H_1) –** There is a significant relation between high BMI Index and per day cost of treatment

Table 4.11. High BMI Index Patients and per day cost of treatment

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
4A2	Between Groups	3.597	9	.400	1.969	.040
	Within Groups	18.060	89	.203		
	Total	21.657	98			
4A3	Between Groups	5.519	9	.613	3.013	.003
	Within Groups	18.117	89	.204		
	Total	23.636	98			
4A4	Between Groups	6.946	9	.772	3.985	.000
	Within Groups	17.236	89	.194		
	Total	24.182	98			
4A5	Between Groups	1.351	9	.150	2.591	.011
	Within Groups	5.154	89	.058		
	Total	6.505	98			

Interpretation: Since computed F value is more than the tabulated F value and p<0.05, Alternate hypothesis is accepted and hence this parameter varies with the per day cost of treatment.

- **ANOVA of use of Dapagliflozin and patient ability to tolerate side effect:**

- **Null Hypothesis (H_0)** – There is no significant relation between use of Dapagliflozin and patient ability to tolerate side effect
- **Alternate Hypothesis (H_1) –** There is a significant relation between use of Dapagliflozin and patient ability to tolerate side effect

Table 4.12. ANOVA Dapagliflozin and patient ability to tolerate side effect

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
3A2	Between Groups	4.074	3	1.358	10.856	.000
	Within Groups	11.885	95	.125		
	Total	15.960	98			
3A3	Between Groups	3.196	3	1.065	6.157	.001
	Within Groups	16.440	95	.173		
	Total	19.636	98			
3A4	Between Groups	2.446	3	.815	3.655	.015
	Within Groups	21.191	95	.223		
	Total	23.636	98			
3A5	Between Groups	3.643	3	1.214	12.697	.000
	Within Groups	9.085	95	.096		
	Total	12.727	98			

Interpretation: Since computed F value is more than the tabulated F value and $p<0.05$, Alternate hypothesis is accepted and hence this parameter varies with patient ability to tolerate side effect.

- **ANOVA of Different factors and Brand Loyalty:**

- **Null Hypothesis (H_0)** – There is no significant relation between Different factors and Brand Loyalty
- **Alternate Hypothesis (H_1) –** There is a significant relation Different factors and Brand Loyalty

Table 4.13. ANOVA Different Factors and Brand Loyalty

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
CF	Between Groups	12.548	3	4.183	.975	.408
	Within Groups	407.634	95	4.291		
	Total	420.182	98			
NCF	Between Groups	7.107	3	2.369	.295	.829
	Within Groups	762.529	95	8.027		
	Total	769.636	98			

Interpretation: Since computed F value is less than the tabulated F value and $p>0.05$ for clinical and non-clinical factors, Null hypothesis is accepted and hence this parameter doesn't vary with Brand Loyalty.

CHAPTER 5

SUMMARY OF FINDINGS AND RECOMMENDATIONS

5.9 DISCUSSIONS AND CONCLUSIONS

This study was carried out with the aim to explore the prescribing patterns of first- and second-line agents for the management of type 2 diabetes and the factors affecting them. The most commonly prescribed first-line antidiabetic was found to be metformin, followed by sulfonylurea. This findingmay be explained by the fact that metformin and sulfonylureas are less expensive and readily available in most healthcare facilities in our country.

Moreover, metformin is the recommended first-line choice, unless contraindicated, in the updated ADA and EASD guidelines. Furthermore, in our study, GLP-1 were found to be the most commonly prescribed second-line antidiabetic followed by DPP-4 inhibitors. Sulfonylureas and DPP-4 inhibitors were also found to be the most commonly prescribed second-line antidiabetics when the first-line is insufficient to control diabetes. I found some significant differences in the factors affecting the prescribing patterns between different demographic characteristics.

Following metformin as first line antidiabetic therapy, sulfonylureas and DPP4 inhibitors were found to be the most considered choices as second-line antidiabetic therapy respectively when the first-line was contraindicated or not sufficient to control diabetes. SGLT2 inhibitors and metformin were considered the preferred choices for patients with established cardiovascular disease.

There is a need to provide targeted education to the prescribers related to the newer diabetes guidelines in order to promote the use of more evidence-based and safer antidiabetics. I expect that my findings will help understand the rational use of antidiabetics for patients with type 2 diabetes. As to two independent samples t-test results, there is a no significant difference between Clinical, Non-Clinical, Market Factors and Type of Hospital.

5.10 RECOMMENDATIONS

The whole aim of this study was to identify the doctor's prescribing behaviour when it comes to anti diabetics and analyse the potential of dapagliflozin in future. It will help in analysing the market trends for anti-diabetics and other drugs in future. Pharma companies in India are heading towards making innovative steps to control diabetes in India due to its recent increase in Incidence and prevalence rate in last 10-15 years. However, the anti-diabetics drugs currently prevailing in the market have been discovered in Late 1990s and new innovative molecules haven't entered the marketwith expected speed.

Diabetes is a chronic disease and in the last few stages it starts affecting the functionality of other organs also, so the cardioprotective nature of Dapagliflozin was widely accepted by physicians in abroad and now it is getting its place in India also. Dapagliflozin was mainly marketed by AstraZeneca as "Farxiga", Sun Pharma "Oxra" in India due to Sun Pharma and AstraZeneca Partnerships in India. I believe that AstraZeneca should increase its partnerships with other firms to penetrate Indian market with this new class of Anti diabetics.

Since the Patent Litigation regarding Farxiga has been settled, so a greater number of firms in pharmaceutical industry should launch their Dapagliflozin brands in India to make it more affordable. The Sglt2 have other successful drugs life empagliflozin so their penetration in to the market will definitely help the patients to get more efficient management of diabetes
Many foreign companies are running clinical trials on dapagliflozin combinations for more effective treatment of co morbidity conditions in Diabetes and Boehringer Ingelheim has started it with a new

combination of Dapagliflozin with Vildagliptin, which is both Cardio protective and renal protective as well and this drug saw a huge 35% YOY growth.

5.11 LIMITATIONS OF STUDY AND FUTURE RESEARCH

In respect to limitations of the study, first, it is necessary to bear in mind encountered time and budgetary constraints. These restrictions are about the sample, not separated into two different groups as private and public, but evaluated together as a single one.

Although the results can be generalized for India, it may be difficult to say exactly the same things, especially concerning market factors and other patient related demographic factors, for other countries based on cultural and demographic differences. As a result, further research needs to be carried out in order to achieve a deeper understanding and for the clarification of the subject.

5. References

1. Al AdAwi, R. M., Jassim, Z., Elgaily, D., Abdelaziz, H., Sree, B., & Mohamed Ibrahim, M. I. (2019). Assessment of dapagliflozin effectiveness as add-on therapy for the treatment of type 2 diabetes mellitus in a Qatari population. *Scientific Reports*, *9*(1), 6864. https://doi.org/10.1038/s41598-019-43052-6
2. Allyhiani, M., Kurdi, A., Abdulaziz, A., Faqeh, S., Alhajjaji, A., Alansari, S., Althaqafi, A., Alzaman, N., & Ali, M. (2022). Prescribing patterns of antidiabetics in type 2 diabetes and factors affecting them. *Saudi Pharmaceutical Journal: SPJ: The Official Publication of the Saudi Pharmaceutical Society*, *30*(2), 112–119. https://doi.org/10.1016/j.jsps.2021.12.019
3. Ashutosh, K., Ipseeta, R. M., & Sandeep, R. (2017). Assessment of prescription pattern of antidiabetic drugs in the outpatient department of a tertiary care hospital. *International Journal of Clinical Endocrinology and Metabolism*, *3*(1), 001–007. https://doi.org/10.17352/ijcem.000021
4. *Dapagliflozin in patients with type 2 diabetes mellitus Theodosios D. Filippatos, Evangelos N. Liberopoulos, and Moses S. Elisafcorresponding author*. (n.d.).
5. Nicholson, M. K., Ghazal Asswad, R., & Wilding, J. P. (2021). Dapagliflozin for the treatment of type 2 diabetes mellitus - an update. *Expert Opinion on Pharmacotherapy*, *22*(17), 2303– https://doi.org/10.1080/14656566.2021.1953471
6. Bagepally, B. S., Chaikledkaew, U., Youngkong, S., Anothaisintawee, T., Thavorncharoensap, M., Dejthevaporn, C., & Thakkinstian, A. (2021). Cost-utility analysis of dapagliflozin compared to sulfonylureas for type 2 diabetes as second-line treatment in Indian healthcare payer's perspective. *ClinicoEconomics and Outcomes Research: CEOR*, *13*, 897–907. https://doi.org/10.2147/CEOR.S328433
7. Singla, R., Bindra, J., Singla, A., Gupta, Y., & Kalra, S. (2019). Drug prescription patterns and cost analysis of diabetes therapy in India: Audit of an endocrine practice. *Indian Journal of Endocrinology and Metabolism*, *23*(1), 40–45. https://doi.org/10.4103/ijem.IJEM_646_18
8. Bagheri, N., McRae, I., Konings, P., Butler, D., Douglas, K., Del Fante, P., & Adams, R. (2014). Undiagnosed diabetes from cross-sectional GP practice data: an approach to identify communities with high likelihood of undiagnosed diabetes. *BMJ Open*, *4*(7), e005305. https://doi.org/10.1136/bmjopen-2014-005305
9. Beagley, J., Guariguata, L., Weil, C., & Motala, A. A. (2014). Global estimates of undiagnosed diabetes in adults. *Diabetes Research and Clinical Practice*, *103*(2), 150–160. https://doi.org/10.1016/j.diabres.2013.11.001
10. Cho, N. H., Shaw, J. E., Karuranga, S., Huang, Y., da Rocha Fernandes, J. D., Ohlrogge, A. W., & Malanda, B. (2018). IDF Diabetes Atlas: Global estimates of diabetes prevalence for

2017 and projections for 2045. *Diabetes Research and Clinical Practice*, *138*, 271–281. https://doi.org/10.1016/j.diabres.2018.02.023

11. Fisher-Hoch, S. P., Vatcheva, K. P., Rahbar, M. H., & McCormick, J. B. (2015). Undiagnosed diabetes and pre-diabetes in health disparities. *PloS One*, *10*(7), e0133135. https://doi.org/10.1371/journal.pone.0133135
12. *India*. (n.d.). Diabetesatlas.Org. Retrieved June 19, 2022, from https://diabetesatlas.org/data/en/country/93/in.html
13. Kesavadev, J., Krishnan, G., & Mohan, V. (2021). Digital health and diabetes: experience from India. *Therapeutic Advances in Endocrinology and Metabolism*, *12*, 20420188211054676. https://doi.org/10.1177/20420188211054676
14. Mathur, P., Leburu, S., & Kulothungan, V. (2022). Prevalence, awareness, treatment and control of diabetes in India from the countrywide national NCD monitoring survey. *Frontiers in Public Health*, *10*, 748157. https://doi.org/10.3389/fpubh.2022.748157
15. Pradeepa, R., & Mohan, V. (2021). Epidemiology of type 2 diabetes in India. *Indian Journal of Ophthalmology*, *69*(11), 2932–2938. https://doi.org/10.4103/ijo.IJO_1627_21
16. Kumar Sharma, E. (2020, October 7). *Diabetes drug dapagliflozin needs to brace for price war, analysts say*. Thewire.In. https://science.thewire.in/health/diabetes-dapagliflozin-sglt-2-astrazeneca-zydus-healthcare-price-war/
17. Lam, D., & Shaikh, A. (2021). Real-life prescribing of SGLT2 inhibitors: How to handle the other medications, including glucose-lowering drugs and diuretics. *Kidney360*, *2*(4), 742–746. https://doi.org/10.34067/KID.0000412021
18. Leo, L. (2020, January 9). *Drugs sales hit 3-year high on demand for anti-diabetic, cardiac care medicines*. Mint. https://www.livemint.com/companies/news/pharma-sales-growth-for-2019-fastest-in-3-years-11578576468639.html
19. Sriram, S., Elizabeth, A. A., & Akila, L. (2020). Cost analysis of SGLT2 inhibitors in patients with type 2 diabetes in India. *Research Journal of Pharmacy and Technology*, *13*(12), 5861–5865. https://doi.org/10.5958/0974-360x.2020.01021.5
20. The Pharma Letter. (n.d.). *India calls for safety warnings of SGLT- inhibitor diabetes drugs*. Thepharmaletter.Com. Retrieved June 19, 2022, from https://www.thepharmaletter.com/article/india-calls-for-safety-warnings-of-sglt-inhibitor-diabetes-drugs

    s

ANNEXURE

Survey Questionnaire

Objective – To analyse market potential and preference of Dapagliflozin over other drugs used in Type2 Diabetes

---

Name of Doctor –

Name of Hospital –

Location of Hospital -

Q1. Please rate the following Clinical factors on a scale of (1-5) on the basis of factors affecting your drug treatment choices for the patients, (where 1 represents unimportant and 5 represents most important)

Comorbidities	**1**	**2**	**3**	**4**	**5**
Hepatic Function	**1**	**2**	**3**	**4**	**5**
History of cardiovascular disease	**1**	**2**	**3**	**4**	**5**
Last measured HbA1c	**1**	**2**	**3**	**4**	**5**
Lipid Profile	**1**	**2**	**3**	**4**	**5**
Post – prandial Glucose levels	**1**	**2**	**3**	**4**	**5**
Pre – Prandial Glucose levels	**1**	**2**	**3**	**4**	**5**
Renal Functions	**1**	**2**	**3**	**4**	**5**
Drug Effectiveness	**1**	**2**	**3**	**4**	**5**
Patient Ability to tolerate side effects	**1**	**2**	**3**	**4**	**5**

Q2. Please rate the following non-Clinical factors on a scale of (1-5) on the basis of factors affecting your drug treatment choices for the patients, (where 1 represents unimportant and 5 represents most important)

Age	**1**	**2**	**3**	**4**	**5**
BMI	**1**	**2**	**3**	**4**	**5**
Dietary Habits	**1**	**2**	**3**	**4**	**5**
Duration of Diabetes	**1**	**2**	**3**	**4**	**5**
Route of Drug Administration	**1**	**2**	**3**	**4**	**5**
Patient Compliance	**1**	**2**	**3**	**4**	**5**
Potency of Drug	**1**	**2**	**3**	**4**	**5**
Dosing of Medication	**1**	**2**	**3**	**4**	**5**

Q3 Please select the Preferred drug treatment choices for the patients on the basis Duration of Diabetes (multiple choice question)

Drugs	0-5 years	5-10 years	10-15 years	15-20 years	>20 years
SGLT2 inhibitors					
DPP-4 inhibitors					
GLP-1 receptor agonists					
Insulin					
Meglitinides					
Metformin					
Sulfonylureas					
Thiazolidinediones					

Q4. Please select the Preferred drug treatment choices for the patients on the basisof BMI index of the Patient (multiple choice question)

Drugs	<20	20-25	25-30	30-35	35-40	>40
SGLT2 inhibitors						
DPP-4 inhibitors						
GLP-1 receptor agonists						
Insulin						
Meglitinides						
Metformin						
Sulfonylureas						
Thiazolidinediones						

Q5. Please rate the following factors on a scale of (0-5) on the basis of factors affecting your drug treatment choices for the patients, (where 1 represents unimportant and 5 represents most important)

1. Advertisement by Pharmaceutical Company	**1 2 3 4 5**
2. Influence of KOLs	**1 2 3 4 5**
3. Per day Cost of Treatment	**1 2 3 4 5**
4. Insurance status	**1 2 3 4 5**
5. Hospital compliance	**1 2 3 4 5**
6. Morbidity and Mortality reduction	**1 2 3 4 5**
7. Brand Loyalty	**1 2 3 4 5**