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An update on Diabetes: An alarming situation

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ABSTRACT
With its increasing prevalence around the world, diabetes is acknowledged as a serious chronic pandemic disease that affects both developing and developed economies equally and has been given the status of "public health priority" in the majority of those nations. Recent report of The Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) says that 101 million people are estimated to be suffered from diabetes and 136 million people are found prediabetic. The report gives an alarm to all of us to be alert or be ready to face the results. Not only in India, the number of people diagnosed with diabetes is rising rapidly around the globe. Type 1, Type 2, Gestational diabetes and other specific types of diabetes such as LADA and MODY makes four distinct forms of the disease. People with diabetes experience fatigue, thirst, hunger, urination, nausea, vomiting and loss of body fluids. The non-functioning death of pancreatic beta cells is the root cause of diabetes. Autoimmune diseases including Addison's, Hashimoto's and Graves' develop due to this. The likelihood of developing diabetes is raised by predisposing factors like genetics, family history, environment, autoimmunity and high insulin resistance. Diagnostic tests available that can diagnose diabetes in its early and later stages. Miglitol, Metformin, Nateglinide, Pioglitazone, Glipizide, Dapagliflozin, Colestimide, Bromocriptine, etc. are the modern medicines used to treat diabetes. Insulin therapy, Stem cell therapy and islet replacement therapy are the other methods utilized also to treat diabetic patients. Due to the adverse effects of modern medicines, use of herbal medicines is recommended because of its less or no side effects and also its easy availability, along with less intake of carbohydrate, physical exercise and awareness are required. Case study report/Interpretative paper discusses all about diabetes.

I. INTRODUCTION

Diabetes, often referred as diabetes mellitus is a group of metabolic diseases in which the person has high blood glucose (blood sugar), either because of inadequate Insulin production or because the body's cells do not respond properly to insulin or both [5]. Diabetes treatment costs and related consequences place a significant financial strain on both the household and national economies. The majority of diabetes patients in a developing country like India bear a heavy financial burden from out-of-pocket expenses. Over the past few decades, India's diabetes prevalence has increased due to rapid urbanization and socio-economic changes such rural-to-urban migration, a lack of exercise, lifestyle disorders, etc. By 2045, the number is projected patients to be 134 million. The estimated country-level health care spending in India for diabetes mellitus was 31 billion US dollars in 2017, placing India fourth in rank after USA, China and Germany. When considering the financial toll, diabetes alone consumes 5 to 25% of the income of a typical Indian household. Lack of knowledge about diabetes, its risk factors, prevention techniques, healthcare systems, a poor economy, non-adherence to medication etc. are the things responsible for its continuous rise. Together, these challenges and issues make a significant contribution to the economic threat [3].

TYPES OF DIABETES

1) **Type 1 diabetes:** The body does not produce insulin. Some people may refer to this type as Insulin-dependent diabetes, Juvenile diabetes or Early-on set diabetes. People usually develop type 1 diabetes before their 40thyear, often in early adulthood or teenage years. Patients with type 1 diabetes will need to take insulin injections for the rest of their life. They must also ensure proper blood-glucose

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levels by carrying out regular blood tests and following a special diet.

2) **Type2 diabetes:** The body does not produce enough insulin for proper function or the cells in the body do not react to insulin (Insulin resistance). Approximately 90% of all cases of diabetes worldwide are type 2. Some people may be able to control their type 2 diabetes symptoms by losing weight, following a healthy diet, doing plenty of exercise and monitoring their blood glucose levels.

3) **Gestational diabetes**: Studies says that this type affects females during pregnancy. Some women have very high levels of glucose in their blood and their bodies are unable to produce enough insulin to transport all of the glucose into their cells, resulting in progressively rising levels of glucose. Diagnosis of gestational diabetes is made during pregnancy.
The majority of gestational diabetes patients can control their diabetes with exercise and diet [5].

4) **Other Specific Type of Diabetes (Monogenic Types)**
Genetic anomalies in the hormone insulin's internal secretion are the cause of it. It is a disease that develops from mutations in 1 to 5% of patients. This includes infections, certain surgeries, genetic beta cell abnormalities, cancer treatments, illnesses of the pancreas and more. It has MOODY, LADA and endocrinopathies kinds.

4.1 MODY (Maturity onset diabetes of young)
A mutation in an autosomal dominant gene involved in insulin secretion or synthesis causes MODY. Children under the age of 25 are disproportionately affected by hereditary factors. There appears to be a hereditary link to a problem with beta cells. This form of diabetes typically manifests in childhood.

4.2 LADA (Latent autoimmune diabetes in adults)
Lack of Insulin production by the pancreas; otherwise, clinically indistinguishable from Type 1. The inability of pancreatic cells to produce insulin leads to LADA. Teenagers and twenty-somethings experience LADA. The LADA are not like the Type 1.

4.3 Endocrinopathies
Insulin's action or inhibition can be affected by a number of illnesses and diseases. Diseases and conditions that interfere with insulin production include polycystic ovary syndrome (PCOS), cancer of the pancreas and tumors [2].

WHAT IS PREDIABETES
The vast majority of patients with type 2 diabetes initially had prediabetes. Their blood glucose levels where higher than normal but not high enough to merit a diabetes diagnosis. The cells in the body are becoming resistant to Insulin.

DIABETES IS A METABOLISM DISORDER
Diabetes (Diabetes mellitus) is classed as a metabolism disorder. Metabolism refers to the way our bodies used ingested food for energy and growth. Most of what we eat is broken down into glucose. Glucose is a form of sugar in the blood-it is the principal source of fuel for our bodies. When our food is digested, the glucose makes its way into our blood stream. Our cells use the glucose for energy and growth. However, glucose cannot enter our cells without insulin being present Insulin makes it possible for our cells to take in the glucose. Insulin is a hormone that is produced by the pancreas. After eating, the pancreas automatically releases an adequate quantity of insulin to move the glucose present in our blood into the cells, as soon as glucose enters the cells blood-glucose levels drop.

A person with diabetes has a condition in which the quantity of glucose in the blood is too elevated (Hyperglycemia). This is because the body does not produce enough Insulin, produces no Insulin or has cells that do not respond properly to the Insulin the pancreas produces. This results in too much glucose building up in the blood. This excess blood glucose eventually passes out of the body in urine. So, even though the blood has plenty of glucose, the cells are not getting it for their essential energy and growth requirements.

DIAGNOSIS OF DIABETES
Diabetes can often be detected by carrying out a urine test, which finds out whether excess glucose is present. This is normally backed up by a blood test, which measures blood glucose levels and can confirm if the cause of the symptoms is diabetes [4].

Diagnostic tests for diabetes, prediabetes or neither [4]

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A patient has a normal metabolism, prediabetes or diabetes can be determined by one of three different ways:

a. The A1C test (Glycated hemoglobin/Glycosylated hemoglobin/Hemoglobin A1C/HbA1C test)

Table 1: Shows AIC% in different conditions of diabetes, prediabetes and normal

S.NO.	CONDITION	A1C%
1	Diabetes	At least 6.5%
2	Prediabetes	Between 5.7% and 5.99%
3	Normal	Less than 5.7%

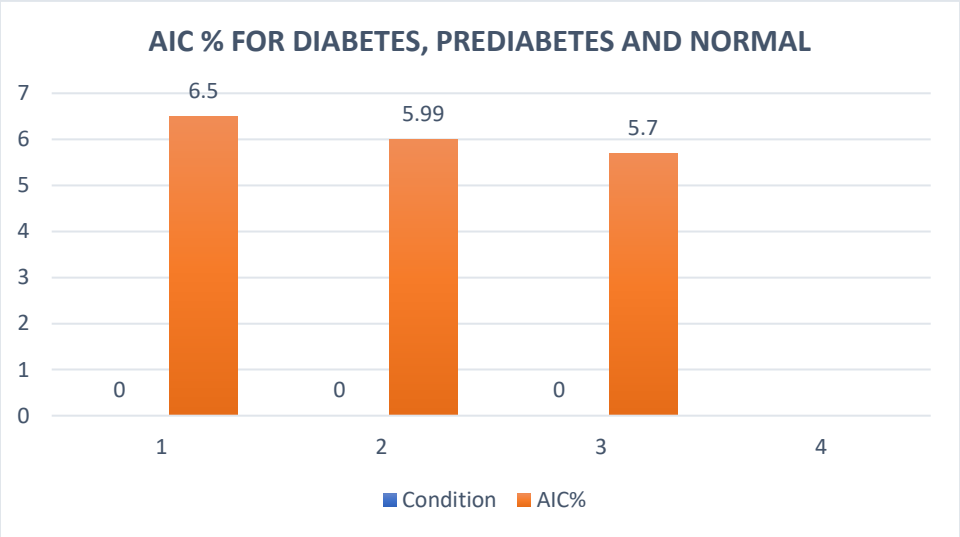

Figure 1: Graph shows the AIC% for diabetes, prediabetes and normal

b. The FPG (Fasting plasma glucose) test

Table 2: Shows the FPG levels in conditions of diabetes, prediabetes and normal

S.NO.	CONDITION	FPG LEVEL
1	Diabetes	At least 126 mg/dl
2	Prediabetes	Between 100 mg/dl and 125.99 mg/dl
3	Normal	Less than100 mg/dl

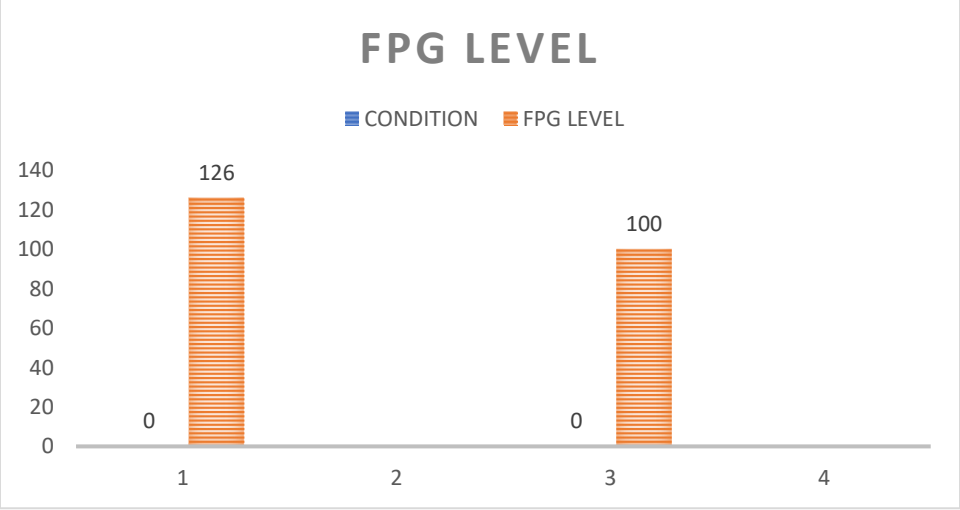

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Figure 2: Graph shows the FPG levels for diabetes, prediabetes and normal

c. The OGTT (Oral glucose tolerance test)

Table 3: Shows OGTT levels for diabetes, prediabetes and normal

S.NO.	CONDITION	INFERENCE
1	Diabetes	At least 200mg/dl
2	Prediabetes	Between 140 and 199.9 mg/dl
3	Normal	Less than140mg/dl

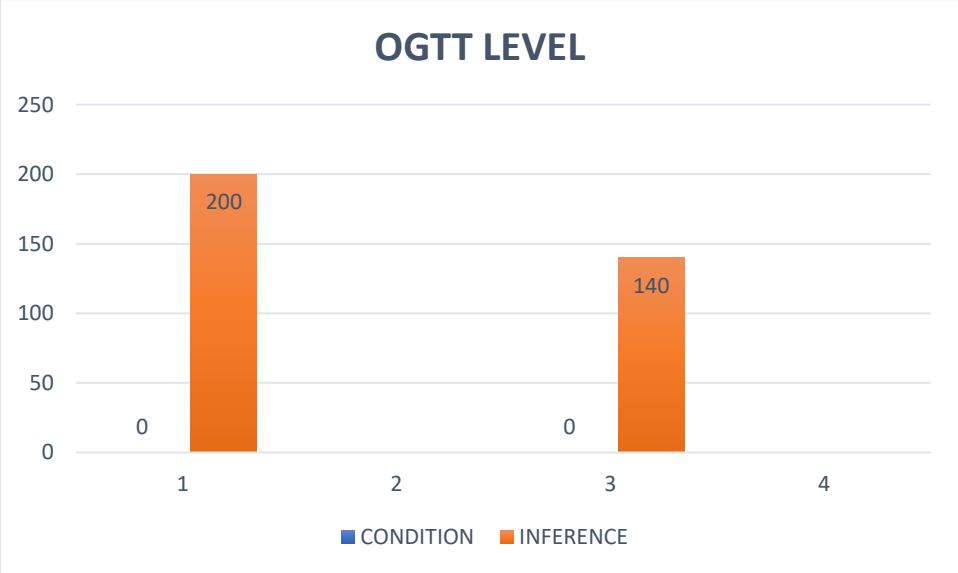

Figure 3: Graph shows the OGTT levels of diabetes, prediabetes and normal

Treatment of Type 1 & 2 diabetes:

Diabetes type1 lasts a lifetime, there is no known cure. Type 2 usually lasts a life time; however, some people have managed to get rid of their symptoms without medication, through a combination of yoga, exercise, diet and body weight control.

Patients with type 1 are treated with regular insulin injections, as well as a special diet, yoga and exercise. Patients with Type 2 diabetes are usually treated with tablets, exercise and a special diet but sometimes insulin injections are also required. If diabetes is not adequately controlled the patient has a significantly higher risk of developing complications.

COMPLICATIONS LINKED TO BADLY CONTROLLED/UNTREATED DIABETES

Table 4: Below is a list of possible complications that can be caused by badly controlled diabetes [4]:

S.No.	COMPLICATIONS	DISEASES/PROBLEMS
1	Eye complications	Glaucoma, Cataracts, Diabeticretinopathy and some others.
2	Foot complications	Neuropathy, Ulcers and sometimes gangrene.
3	Skin complications	Skin infections and skin disorders.
4	Heart problems	Ischemic heart disease, when the blood supply to the heart muscle is diminished.
5	Hypertension	Common in people with diabetes, which can raise the risk of kidney disease, eye problems, heart attack and stroke.
6	Mental health	Uncontrolled diabetes raises the risk of suffering from depression, anxiety and some other mental disorders.

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7	Hearing loss	Diabetes patients have a higher risk of developing hearing problems.
8	Gum disease	Much higher prevalence of gum disease among diabetes patients.
9	Gastroparesis	Stomach muscles stop working properly.
10	Ketoacidosis	A combination of ketosis and acidosis; accumulation of ketone bodies and acidity in the blood.
11	Neuropathy	Diabetic neuropathy is a type of nerve damage which can lead to several different problems.
12	HHNS (Hyperosmolar Hyperglycemic Nonketotic Syndrome)	Blood glucose levels shoot up too high and there are no ketones present in the blood or urine. It is an emergency condition.
13	Nephropathy	Uncontrolled blood pressure can lead to kidney disease.
14	PAD (Peripheral arterial disease)	Pain in the leg, tingling and sometimes problem in walking.
15	Stroke	If blood pressure, cholesterol levels, and blood glucose levels are not controlled, the risk of stroke is very high.
16	Erectile dysfunction	Male impotence.
17	Infections	People with uncontrolled diabetes are much more susceptible to infections.
18	Healing of wounds	Delay in healing of cuts and lesions.

SYMPTOMS OF DIABETES

Table 5: Here is a list of the most common diabetes symptoms [4]:

S.No.	Symptoms	What/Why happens?
1	Frequent urination	When there is too much glucose (sugar) inthe blood, urination occurs more often. If Insulin is ineffective, the kidneys cannot filter the glucose back into the blood. The kidneys will take water from the blood in order to dilute the glucose - which in turn fills up the bladder.
2	Disproportionate thirst	If urination is more than usual, there is a need to replace that lost liquid.
3	Intense hunger	As the insulin in the blood is notworking properly or is not there at all, and the cells are not getting their energy, your body may react by trying to find more energy-food. You will become hungry.
4	Weight gain	Intense hunger.
5	Unusual weight loss	This is more common among people with Diabetes Type 1 because the body is not making insulin it will seek out another energy source (the cells aren't getting glucose). Muscle tissue and fat will be broken down for energy. As Type1 is of a more sudden onset and Type2 is much more gradual, weight loss is more noticeable with Type1.
6	Increased fatigue	If insulin is not working properly or is not there at all, glucose will not enter the cell sand provide them energy. This will make tired.
7	Irritability	Irritability can be due to lack of energy.
8	Blurred vision	This can be caused by tissue being pulled from the eye lenses. This affects the eyes ability to focus. With proper treatment this can be treated. There are severe cases where blindness or prolonged vision problems can occur.
9	Cuts and bruises don't	Cuts and bruises take much longer time than usual to heal. When

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	heal properly or quickly	there is more sugar (glucose) in the body, its ability to heal is reduced.
10	More skin and/or yeast infections:	When there is more sugar in the body, its ability to recover from infections is affected. Women with diabetes have difficulty to recover from bladder and vaginal infections.
11	Itchy skin	A feeling of itchiness on the skin is sometimes a symptom of diabetes.
12	Gums are red and/or swollen-Gums pull away from teeth	If the gums are tender, red and/or swollen this could be a sign of diabetes. The teeth could become loose as the gums pull away from them.
13	Frequent gum disease/infection	Experience of more frequent gum disease and/or gum infections.
14	Sexual dysfunction among men	In age of 50 years or more, frequent experience of constant sexual dysfunction (Erectile dysfunction), it could be a symptom of diabetes.
15	Numbness or tingling, especially in feet and hands	If there is too much sugar in the body, the nerves could be come damaged, as could the tiny blood vessels that feed those nerves. One may experience tingling and/or numbness in hands and feet.

RECENT REPORT OF THE INDIAN COUNCIL OF MEDICAL RESEARCH-INDIA DIABETES (ICMR-INDIAB)

ICMR-INDIAB did a study/survey to find out how common metabolic no communicable diseases (NCDs) are in the country. The NCDs are diseases that can't be spread from person to person. The survey was done between 2008 and 2020 in 31 states and union territories including1, 13, 043 people (33,537 urban people and 79,506 rural people). The results found are given in the table below and number of people included in the survey.

Table 6: ICMR-INDIAB's Non-communicable diseases estimations

S.No.	Particulars	Estimations
1	Diabetes	101 million estimated
2	Prediabetes	136 million found
3	Hypertension	315 million found
4	Generalized obesity	254 million
5	Abdominal obesity	351 million
6	Hypercholesterolaemia (Highcholesterol)	213 million
7	High LDL cholesterol or bad cholesterol.	185 million

The survey also revealed that the southern and northern regions of India had the greatest rates of diabetes prevalence, with urban areas like Kerala, Puducherry, Goa, Sikkim, and Punjab reporting the highest rates of NCDs in comparison to other regions of India. The findings of the population-based, cross-sectional study on persons over the age of 20 revealed that:

i. The prevalence of generalised obesity was substantially greater in females. Only high cholesterol was considerably greater in males, while hypercholesterolemia, low HDL cholesterol and high LDL cholesterol were significantly higher in females.
ii. The only lipid parameter that was significantly higher in males was high cholesterol.
iii. The prevalence of prediabetes was found to be at its lowest in Punjab, Jharkhand, and certain portions of the north-eastern region of India.
iv. It was found to be at its highest in the central and northern regions of India. On the other hand, there was no discernible difference between urban and rural locations in terms of the prevalence of prediabetes.
v. Other cardiometabolic risk factors, such as obesity, hypertension, and dyslipidemia, have a prevalence that is

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uniformly high across the country, particularly in metropolitan regions. This is especially true for the prevalence of obesity. In general, hypertension was quite common across the country with the exception of the central region; nevertheless, it was more widespread in the metropolitan areas.

vi. When compared to rural areas, the prevalence rates of generalised obesity as well as abdominal obesity were shown to be significantly higher in urban areas.

vii. Although rates of abdominal obesity were high across the board in India, the southern region had the highest prevalence of obesity overall, followed by the northern and eastern parts of the country.

viii. There was not much of a difference between urban and rural areas in terms of the prevalence of high hypertriglyceridemia and low HDL cholesterol. This was the case throughout India.

ix. Hypercholesterolemia and high LDL cholesterol revealed a wide range of interstate and interregional variability, with the highest frequency found in the northern area, Kerala, and Goa.

x. According to the study, the prevalence of diabetes and related NCDs putting a large population at risk for both cardiovascular disease and chronic complications of diabetes like kidney, foot, and eye disease, the treatment of which is extremely expensive for both the individual and society as a whole.

xi. Furthermore, the prevalence of obesity and prediabetes is high throughout the nation (even in areas where the prevalence of diabetes is currently low), which suggests that the epidemic will continue to spread.

xii. According to the article, rural areas generally lack the infrastructure necessary to care for a growing number of people with diabetes and its complications. This makes the universally high incidence of prediabetes in these places a cause for serious concern [1].

Table7: Different parameters of Diabetes Mellitus

	Type 1	**Type 2**	**MODY**	**LADA**
Typical Age of Onset	Youth	Adult	Youth	Adult
Presence of Autoantibodies	Yes	No	No	Yes
Insulin Dependence	Yes	No	Not Always	Yes, within years
Insulin Resistance	No	Yes	Yes	No
Progression to Insulin Dependence	Rapid	Slow	Slow	Month/Year

DIAGNOSTIC/LABORATORY TESTS

Fasting plasma glucose test, Oral glucose tolerance test, Random blood glucose test, Hemoglobin AIC test and O'Sullivan Test **(**GD can be evaluated with this test. Fifty grammes of glucose is given to a patient who has been fasting for several hours. Every hour, a blood sample is taken. When plasma concentrations above 1500 ng/mL, GD is suspected.)

MANAGEMENT OF DIABETES

Since type 1 is brought on by an autoimmune deficiency, it cannot be prevented. Simple modifications to one's diet and fitness routine through exercise are at the heart of the vast majority of diabetes preventative and treatment plans. Genes and ageing are contributing factors to Type 2. Methods to postpone or avoid developing Type 2 diabetes are discussed below.

i. If you are overweight, you should make an effort to lose weight by engaging in both regular exercise and a nutritious diet. Aim for 20 minutes or more of aerobic exercise each day. A person becomes physically, mentally, and socially healthy via regular exercise. Exercise on a regular basis helps to maintain a healthy body weight, lower blood sugar levels, and manage high blood pressure and high cholesterol. As a result, the risk of disorders like cardiovascular diseases that are associated to those conditions is reduced. Long stretches of inactivity are another risk factor for Type 2 diabetes. Bariatric surgery may also be an option for obese individuals with a BMI > 35.

a. Carbohydrates should be eliminated from the

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diet.

b. Increase your intake of fruits, veggies, and whole grains every day.

c. There is a lot of sugar in alcohol, so drinking it in large quantities is unhealthy.

Insulin Therapy

Insulin therapy is used to treat Type 1 diabetics. The aim of insulin therapy is to keep blood sugar levels under control or maintained. Using an insulin pump, insulin pen, or syringe, it is administered subcutaneously.

Table 9: Types of Insulin

Particulars	Categories of Insulin				
	Rapid acting	**Short/regular acting**	**Intermediate acting**	**Long acting**	**Ultra long acting**
Onset	15 minutes	30 minutes	2-4 hours	2 hours	6 hours
Peak time	1-2 hours	2-3 hours	4-12 hours	No peak	No peak
Duration	2-4 hours	3-6 hours	12-18 hours	24 hours or more	36 hours or more
Example	Humulin R, Velosulin R	Humulin R, Novolin N	Degludec, Glargine	Glarginer, Detemir, Degludec	Glargine U-300

Islet Replacement Therapy

Traditional in vitro therapies such as insulin injections have the drawback of not effectively treating diabetes. For diabetic patients, islet replacement therapy is an alternative form of care. In this therapy, pancreatic or islet cell transplants are used to replace beta cells that produce insulin. Given the poor success rate, it is occasionally employed. Islet transplants present a number of difficulties, including a lack of available donors, proper islet graft function, long-term survival, etc.

Stem cell therapy

Stem cells play a crucial role in human development. Type 1 diabetes can be treated with stem cell treatment. To reverse Type 1 diabetes, we need more than just a replacement for the pancreatic beta cells that have been destroyed by the disease. Stem cells have this quality, which aids in the healthy operation of insulin-producing pancreatic beta cells, which keeps blood sugar levels stable [2].

MODERN MEDICINES TO TREAT DIABETES

Table10:Modern anti-diabetic drugs with its generic name and action [2]

Generic name of drug	Drug category	Drug action	Adverse effects
Acarbose, Miglitol	Alpha glucosidase inhibitors	Slow breakdown of oligosaccharide and disaccharides into monosaccharides, prevents/delays absorption	Flatulence and diarrhea
Metformin	Biguanides	Lowers the hepatic glucose output and increase uptake of glucose by the periphery, including skeletal muscle.	Moderate weight loss
Repaglinide, Netaglinide	Meglitinides	Its trigger the beta cells of the pancreas to increase the secretion of insulin.	Hypoglycemia
Pioglitazone, Rosiglitazone	Thiazolidinediones	It improves insulin sensitivity in adipose tissue and skeletal muscle for good work	Skin allergies, chest pain, heart failure
Glimepride, Glibenclamide, Glipizide	Sulfonylureas	Increase insulin secretion by stimulating beta	Hypoglycemia, cardiovascular diseases

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		pancreatic cells	
Empagliflozin, Canagliflozin, Ipraglifozin	Sodium glucose co-transporter inhibitors	Lower blood glucose levels by blocking the reabsorption of glucose in the kidney and improve glucose excretion	Vaginal yeast infections, Urinary tract infections
Colesevelam, Colestimide	Bile acid sequestrants	Developed glucose lowering effect and improved tolerance	Constipation, heart burn, bloating
Bromocriptine	Dopamine D2 receptor agonist	Improves insulin sensitivity and lower insulin resistance.	Cardiac arrhythmia, hypotension

HERBAL MEDICINAL DRUGS USED FOR DIABETES

The medicinal plants and herbs are currently being used in various configurations for their anti-diabetes activity. Multiple clinical studies have confirmed that extracts from healing herbs have an anti-diabetic effect and can restore pancreatic-cell function [4].

Table 11: List of some reported herbal drugs used to treat diabetes

S.No.	Scientific name	Local name	Family
1	Aloe barbadensis	Ghritkumari, Ghikanvar	Liliaceae
2	Allium sativum	Garlic, Lassan	Liliaceae
3	Ocimum sanctum	Tulsi	Labiateae
4	Coriandrum sativum	Dhaniya	Apiaceae
5	Aegle marmelos	Bael	Rutaceae
6	Tinosporacardifolia	Giloy, Guduchi, Amrita	Menispermaceae
7	Mangifera indica	Aam	Anacardiaceae
8	Momordica Charantia	Bitter Gourd, Karela	Cucurbitaceae
9	Allium Cepa	Onion, Pyaz	Liliaceae
10	Azadirachta indica	Neem	Meliaceae
11	Eugenia jambolana	Jamun, Kala jamun, Blackberry	Myretaceae
12	Gymnemasylvestre	Gudmar, Meshashringi	Asclepidaceae
13	Carica papaya	Papita	Caricaceae
14	Psidium Guajava	Guava, Amrood	Myrtaceae
15	Thea Sinesis	Tea	Theaceae

II. CONCLUSION

Types, symptoms, causes, diagnosis, and treatment of Diabetes are all covered in this article. Diabetes has evolved into a widespread, age-independent disease. While insulin therapy and other anti-diabetic medications can help manage diabetes for some time, the illness itself cannot be cured. Diabetic patients must adhere to a healthy diet and maintain a regular exercise routine. The number of people with diabetes in India and elsewhere is rising rapidly. Without effective treatment, the disease will spread to many people all over the world. An extremely common endocrine condition that affects many people worldwide is diabetes mellitus. It is a group of metabolic infections characterized by hyperglycemia brought on by abnormalities in insulin release, activity, or both. Moving the research towards generally available medications with low symptom and wide range of bio action and don't require difficult pharmaceutical combination appears to be profoundly important given the growth in obstruction and populations of patients at some risk, related to the limited number of commercially available medications for diabetes that despite everything present have many side effects and furthermore issues like undesirable hypoglycemic impact. When creating medications and treating the hyperglycemic problem associated with diabetes mellitus, substances and concentrates that are not derived from various common resources play a vital role. The purpose of this

article is to inform readers that there are western medications and Indian traditional healing herbs available for the treatment of diabetes mellitus. For this reason, medicines developed in accordance with the principles of western medicine (Allopathy) are sometimes limited in their viability, carry the risk of adverse effects, and are frequently unnecessarily expensive, especially for developing countries like India. To manage type-1 and type-2 diabetes mellitus and related complications, medicinal herbs are used. The use of medicinal homegrown plants as a treatment for diabetes is widely accepted worldwide.

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