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Revolutionizing Insulin Administration: Precision & Convenience through CGM by AI-Powered Automation using Tableau.

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ABSTRACT- A series of illnesses known as diabetes mellitus alter how the body utilizes blood sugar (glucose). The cells that make up the muscles and tissues rely heavily on glucose as a source of energy. It serves as the primary fuel for the brain. This article centres on our proposal to improve how a person can manage their illness and take preventative measures without having to be constantly watched over. We also propose to make treatments better, faster, and most importantly safe, allowing the patient to live a normal life without being constantly reminded of the illness they have. It is evident that people with high-risk health conditions such as diabetes, hypertension (blood pressure), cardiovascular disease, obesity, etc. find it challenging to live a normal life. The idea will improve the way insulin is being dispensed by fusing them with innovation and technology, we'll be able to give these folks access to more practical, quick, and effective ways of surviving and enable them lead regular lives.

Key words: Autoantibodies, Neuropathy, Gestational, pre-programmed, Transcutaneous, Implantation.

I. Introduction

In 2016, there were an estimated 415 million cases of diabetes globally; by 2040, it is anticipated that there would be 642 million cases of type 1 diabetes (T1D). A significant advancement has been made by continuous glucose monitoring systems (CGMS) connected to insulin administration. T1D is a dangerous, expensive, and chronic condition that affects children or young adults. In fact, in T1D, the loss of pancreatic beta-cells results in a complete lack of insulin. Blood glucose Carbohydrates, proteins, and lipids make up the majority of the nutrients in diet. Together with starch and fiber, sugars are one of three different categories of carbohydrates. Once sugars have been absorbed by the body, they are typically entirely converted into glucose, which serves as a vital source of energy for the body. The type of sugar that is carried by the bloodstream and absorbed by cells is glucose. Glucose can also be produced by the body from lipids and proteins. Blood glucose [9] is what is meant by blood "sugar".[25] Each form of diabetes has a different primary etiology. Yet, diabetes can result in an excess of sugar in the blood regardless of the type you have. Serious health issues can result from an excess of sugar in the blood. Type 1 diabetes and type 2 diabetes are chronic diabetes diseases [8]. Diabetes disorders including gestational diabetes and prediabetes may be reversible. When blood sugar levels are greater than usual, prediabetes develops. Nonetheless, the blood sugar levels are not elevated enough to be classified as diabetes. Also, if no preventative measures are done, prediabetes might progress to diabetes. Throughout pregnancy, gestational diabetes can develop. Yet it may go away when the baby is delivered. Diabetes mellitus is a condition in which the body does not generate enough or utilize insulin as it should, leading to abnormally high blood sugar (glucose) levels. People may lose weight even when they aren't trying because their thirst and urination are both enhanced. Diabetes harms the nerves and impairs one's sense of touch. The risk of heart attack, stroke, chronic kidney disease, and vision loss increases due to diabetes' erosion of blood vessels. Doctors use a blood sugar test to diagnose diabetes. Patients[6] with diabetes need to maintain a diet free of processed foods[12], refined carbohydrates (especially sugar), and saturated fat. They also need to exercise, maintain a healthy weight, and often take medication to regulate their blood sugar levels. High blood sugar levels are a symptom of diabetes mellitus, a medical illness.

IA. Biomarkers for Diabetes mellitus

It is essential to comprehend how the body usually utilizes glucose if you want to comprehend diabetes. how insulin functions Located below and beneath the stomach, a gland produces the hormone insulin (pancreas). Insulin is released into the circulation by the pancreas. When the insulin moves through the body, sugar might enter the cells. Sugar levels in the blood are reduced by insulin. The amount of insulin the pancreas secretes increases as the blood sugar level decreases. The cells that make up muscles and other tissues use the sugar glucose as an energy source. Food and the liver are the two main sources of glucose. Insulin helps sugar enter cells once it is taken into the circulation. Glucose is created and stored by the liver. The liver converts stored glycogen into glucose when blood glucose levels are low, as they are when you haven't eaten in a while. Your glucose level is kept within a normal range as a result. Most kinds of diabetes lack a recognized precise etiology. Sugar builds up in the bloodstream in every situation. This occurs as a result of inadequate insulin production by the pancreas. Diabetes of either type can result from a mix of hereditary and environmental causes. What such elements could be is unknown.

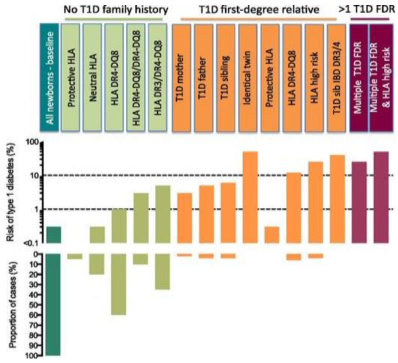

Figure 1: Biomarkers graph. (Sources)

According to HLA and first-degree family history, type 1 diabetes risk. The top graph depicts the background risk of type 1 diabetes in new born of European heritage (y-axis), which is 0.3%, by the age of 20. Infants with no first-degree relatives with type 1 diabetes are at the lowest risk (light green bars), newborns with one first-degree relative with type 1 diabetes (orange bars), and infants with numerous first-degree relatives with type 1 diabetes (dark green bars) (burgundy bars). HLA high risk is defined as having both the HLA DR4-DQ8/DR4-DQ8 and DR3/DR4-DQ8 genotypes. IBD is for identical by descent; sib stands for sibling; and T1D stands for type 1 diabetes. The proportion of type 1 diabetes cases detected by the HLA and/or family history status is depicted in the lower graph.[14]

IB. Risk factors

Risk factors for diabetes depend on the type of diabetes.[22] Family history may play a part in all types. Environmental factors and geography can add to the risk of type 1 diabetes. Sometimes family members of people with type 1 diabetes are tested for the presence of diabetes immune system cells (autoantibodies). If you have these autoantibodies, you have an increased risk of developing type 1 diabetes. But not everyone who has these autoantibodies develops diabetes. The risk of type 2 diabetes may also increase depending on your race or ethnicity. Certain people are more at risk than others, including those who are Black, Hispanic, American Indian, and Asian Americans, however it is unknown why. Those who are overweight or obese are more likely to have gestational diabetes, type 2 diabetes, and pre-diabetes[20].

Many elements can increase your chance of developing type 1 diabetes, such as:

1. **Family background.** A person's chance of getting type 1 diabetes is marginally increased if they have a parent or sibling who has the disease.
2. **Genetics.** Type 1 diabetes is more likely to develop if specific genes are present.
3. **Geography.** When you go farther from the equator, the prevalence of type 1 diabetes tends to increase.
4. **Age.** Any age can see the onset of type 1 diabetes, although there are two distinct peaks. Children between the ages of 4 and 7 experience the first peak. Children between the ages of 10 and 14 are affected by the second.

IC. Complications

Diabetes long-term consequences emerge gradually. The risk of problems increases with the duration of diabetes and the degree to which your blood sugar is under control. Diabetes problems might eventually become incapacitating or even fatal. In actuality, type 2 diabetes can result from prediabetes. Heart and blood vessel (cardiovascular) disease is one example of a potential complication[15]. Diabetes significantly raises the risk of several cardiac conditions. They include heart attacks, strokes, arterial narrowing, and coronary artery disease with chest discomfort (angina) (atherosclerosis). Diabetes increases your risk of developing heart disease or stroke. Damage to the nerves (neuropathy). Sugar can harm the walls of the small blood arteries (capillaries) that supply the nerves, particularly in the legs. This might produce tingling, numbness, burning, or pain, which commonly starts at the tips of the toes or fingers and extends upward. Injury to the digestive nerves might result in nausea, vomiting, diarrhoea, or constipation. It may cause erectile dysfunction in males.

1. **Kidney disease (nephropathy).** The kidneys contain millions of small blood artery clusters (glomeruli) that filter waste from the blood. Diabetes can harm this sensitive filtration mechanism.
2. **Eye damage** (retinopathy). Diabetes can harm the blood vessels in the eyes (diabetic retinopathy). This might lead to blindness.
3. **Foot injury.** Many foot issues are made more likely by nerve injury in the feet or inadequate blood circulation to the feet.
4. **Oral and skin ailments.** You may be more vulnerable to bacterial and fungal infections as a result of diabetes.
5. **Impairment of hearing.** Diabetes patients are more likely to experience hearing issues.
6. **Alzheimer's condition.** Alzheimer's disease and other forms of dementia may be more likely in people with type 2 diabetes.
7. **Depression.** Diabetes patients of both types 1 and type 2 frequently experience depressive symptoms.

II. Current Treatment of Diabetes Mellitus

With type 1 diabetes, many injections of insulin are required. Type 2 diabetes treatment often involves oral medicine, insulin injections, and occasionally intravenous medication. Diet, exercise, and education are the three mainstays of diabetes treatment, and for those with mild diabetes, they are typically the first recommendations. Overweight people ought to slim down. Moreover, those with type 1 diabetes (irrespective of blood glucose levels), as well as those with extremely high or continuously elevated blood glucose levels, require medication[3]. The goal of diabetes therapy[23] is to keep blood glucose levels as close to the normal range as is physically possible because this reduces the likelihood of complications for people with diabetes. V Advice on taking medications, managing diet, and monitoring blood sugar levels can be obtained from a nurse with diabetes education training. Those with diabetes should stop smoking and drink less alcohol (up to one drink per day for women and two for men). Many medications are used to treat diabetes. Injections of insulin are required for type 1 diabetics to lower their blood glucose levels. The majority of type 2 diabetes patients take oral medications to lower blood sugar, but some may also require insulin or other injectable medications.

IIA. Pancreas transplantation

People with type 1 diabetes may occasionally receive a transplant of their entire pancreas or just the insulin-producing cells from a donor pancreas. This method may help people with type 1 diabetes mellitus maintain normal glucose levels. Nevertheless, pancreatic transplants are normally only carried out in patients who have severe diabetes-related problems or who are also getting another donated organ (such as a kidney) and will require immunosuppressants in any case. This is due to the need to provide immunosuppressive drugs to stop the body from rejecting the transplanted cells.

IIB. People who are frail or have medical problems

Both elderly people and those with severe or multiple medical conditions can benefit from the four basic components of diabetes management: education, diet, exercise, and drugs. Nevertheless, trying to strictly control blood glucose levels may be harmful for older people or those with several medical issues since it puts them at risk of developing hypoglycemia (a low blood glucose level). It may be difficult for those with weak eyesight to perceive the dose scales on insulin syringes and glucose meters. Those who have arthritis, Parkinson's disease, or stroke may find it challenging to manage the syringe.

IIC. Medication

It could be troublesome for some individuals to take diabetes medications, particularly insulin. For patients who struggle to accurately fill syringes owing to vision problems or other concerns, a caregiver can prepare the syringes beforehand and preserve them in the refrigerator. For people who consistently take their insulin dosage, prefilled syringes are an option. For people with physical limitations, devices that already have insulin inside them may be simpler. Several of these devices include knobs that are simple to manipulate and have large numerals.

III. Monitoring blood glucose levels

Some people may find it more challenging to monitor blood glucose levels because of poor vision, restricted hand dexterity caused by arthritis, tremor, or stroke, or other physical restrictions. However, there are specialized monitors on the market. Some have huge, easier-to-read number displays. Some deliver instructions and outcomes in aural form. Some monitors don't need blood samples; they can assess blood glucose levels via the skin. A diabetes educator can help people choose the best meter by providing advice. Keeping an eye on blood glucose levels is crucial for diabetes management[28]. Regular blood glucose monitoring gives the data required to change medication, food, and exercise routines as needed. Waiting to monitor blood glucose until there are signs of low or high blood glucose levels might be dangerous.

Hypoglycemia

Low blood glucose levels are the most frequent side effect of treating high blood glucose levels (hypoglycemia). Those who are elderly, seriously ill, frequently admitted to the hospital[20], or who are on a number of drugs are most at risk. Long-acting sulfonylurea drugs or insulin are more likely to result in low blood glucose levels in patients with severe or numerous medical conditions, particularly elderly patients. These people are also more prone to experience major side effects, such as fainting and falling, as well as difficulties with thinking or utilizing certain body parts as a result of low blood glucose levels when taking these drugs. Hypoglycemia may not be as noticeable in older persons as it is in younger people. Hypoglycemia-related confusion might be misinterpreted for dementia or a drug's calming effects. Also, those who have trouble talking (such as those who have dementia or have had a stroke) might not be able to alert others to their symptoms.

Continuous glucose monitor (CGM)

A continuous glucose monitor (CGM), an external device linked to the body that continually measures blood glucose levels, is used by certain persons. Doctors utilize a different measurement when using this kind of gadget to gauge how well blood glucose levels are being managed. They employ a quantity known as time in range. The proportion of a certain period during which the blood glucose level is at the individual's target level is known as time in range. The typical range is 3.9 to 9.9 mmol/L (70 to 180 mg/mL).

These targets are altered for certain persons in whom hypoglycemia is particularly undesirable, such as elderly adults, because intensive therapy to achieve these goals raises the chance that blood glucose could dip too low (hypoglycemia). Other objectives include maintaining a systolic blood pressure under 140 mm Hg and a diastolic blood pressure under 90 mm Hg. The target blood pressure for diabetics with heart disease or who are at high risk for developing heart disease is less than 130/80 mm Hg.

Figure 2: Wireless CGM. (Source)

Monitoring blood glucose levels

Blood glucose levels may be easily monitored anywhere, including at home. Blood glucose levels are most frequently checked with a fingerstick glucose test. Most blood glucose monitors (glucose meters) take a sample of blood by pricking the tip of the finger with a tiny lancet. The lancet has a small needle inside that may be inserted into a finger or a spring-loaded tool that swiftly and easily pierces flesh. Most people discover that the pricking is somewhat uncomfortable. The next step is to apply a blood drop on a reagent strip. Depending on the glucose level, some molecules in the strip undergo modifications. The glucose meter interprets the variations in the test strip and displays the results digitally. Some Systems[13] for continuous glucose monitoring (CGM) employ a tiny glucose sensor buried beneath the skin. Every few minutes, the sensor checks blood glucose levels. There are two varieties of CGMs, each with a distinct goal:

Professional

Professional CGMs gather ongoing data on blood glucose levels throughout time (72 hours to up to 14 days). These details are used by healthcare professionals to suggest treatments[17]. The person with diabetes is not given data by professional CGMs.

Personal

Personal CGMs are used by the person and provide real-time blood glucose data on a small portable monitor or on a connected smart phone. Alarms on the CGM system can be set to sound when blood glucose levels drop too low or climb too high, so the device can help people quickly identify worrisome changes in blood glucose. CGMs can be worn for up to 14 days, often do not require calibration, and can be used for insulin dosing without fingerstick glucose confirmation. There are also systems in which the CGM device communicates with insulin pumps to either stop delivery of insulin when blood glucose is dropping (threshold suspend), or to give daily insulin (hybrid closed loop system). When persons with type 1 diabetes have frequent, quick variations in blood glucose (especially when the glucose levels occasionally drop very low), which are challenging to detect with fingerstick testing, CGM devices can be especially beneficial. Doctors use CGM devices to assess how long a patient's blood glucose remains within a target range in order to define treatment objectives and modify insulin dosage. In order to help doctors and nurses advise patients on how to alter the amount of insulin or the oral antihyperglycemic medicine, patients should keep track of their blood glucose levels and report them to their doctor or nurse. Many people can learn how to independently change their insulin dosage as needed. It may be possible for some patients with moderate or early-stage type 2 diabetes to test their fingerstick glucose levels only occasionally if their condition is well-controlled with one or two drugs.

IV. Diagnosis of diabetes

IVA. Haemoglobin A1C

A blood test called haemoglobin A1C can be used by doctors to monitor the condition of their patients. When blood glucose levels are elevated, haemoglobin, the protein that transports oxygen in the blood, changes. Long-term blood glucose levels are closely connected with these changes. The individual's haemoglobin A1C level is higher, which indicates that their glucose levels have been higher. Haemoglobin A1C testing reveals how effectively blood glucose levels have been controlled over a period of several months, in contrast to blood glucose testing, which only displays the level at a certain time. Haemoglobin A1C levels of fewer than 7% are the target for people with diabetes. Although reaching this level might be challenging, issues are less likely to occur the lower the haemoglobin A1C level is. Depending on a patient's specific health state, doctors may advise a slightly higher or lower objective. Nevertheless, levels above 9% and levels above 12% demonstrate poor and extremely poor control, respectively. Haemoglobin A1C should be checked every three to six months, according to the majority of experts who specialize in treating diabetes.

IVB. Fructosamine

When haemoglobin A1C results are unreliable, such as in people with anemia brought on by a lack of iron, folate, or vitamin B12, or when abnormal forms of haemoglobin, such as those in sickle cell disease or thalassemia, are present, fructosamine, an amino acid that has bonded with glucose, is typically used. Although urine may also be analysed for the presence of glucose, doing so is not a reliable technique to track therapy effectiveness or make changes[18]. Because the quantity of glucose in the urine may not represent the current level of glucose in the blood, urine testing can be deceptive. Without any change in the amount of glucose in the urine, blood glucose levels might fluctuate greatly. Those who struggle to keep their blood sugar levels stable As no insulin is produced, people with type 1 diabetes may experience blood glucose changes more often. Blood glucose fluctuations may also be caused by infections, sluggish digestion of meals, and other hormonal issues. Doctors examine each patient who has trouble regulating blood glucose for other conditions that could be the source of the issue and provide further instruction on how to manage diabetes and take medication.

IVC. Type 1

People diagnosed with type 1 diabetes usually start with two injections of insulin per day of two different types of insulin and generally progress to three or four injections per day of insulin of different types. The types of insulin used depend on their blood glucose levels. Studies have shown that three or four injections of insulin a day give the best blood glucose control and can prevent or delay the eye, kidney, and nerve damage caused by diabetes.[19]

IVD. Type 2

Most people with type 2 diabetes may need one injection per day without any diabetes pills. Some may need a single injection of insulin in the evening (at supper or bedtime) along with diabetes pills. Sometimes diabetes pills stop working, and people with type 2 diabetes will start with two injections per day of two different types of insulin. They may progress to three or four injections of insulin per day. Abstract. With recent technologic advances there has been a resurgence of interest in implantable insulin infusion devices. A satisfactory closed loop system has been elusive. Open loop systems include the pump, delivery catheter, and patient pump communicator. Several such systems are currently undergoing clinical investigation. Implantable pumps can be placed with minimal morbidity. Insulin under delivery is the most frequent long-term problem. Several recent studies suggest that implantable pumps can safely and effectively maintain good glucose control. The development of a satisfactory implantable closed loop system will be the next step in this technology. Intensive insulin therapy and glucose monitoring can prevent the development of end-organ complications in both type I and type II diabetes. However, there are potential adverse effects and patient inconvenience with such treatment, including episodic hypoglycemia, weight gain, and the need for either frequent insulin administration or the use of an external insulin pump and monitoring. Pancreatic islet cell and whole organ transplantation represent management alternatives but have significant associated morbidity. Thus, there has been interest in developing other techniques of insulin delivery for use in diabetic therapy. Implantable insulin infusion devices have been under clinical investigation for almost 20 years. An acceptable system that changes insulin delivery in response to serum glucose levels has remained elusive.

V. Proposed method through CGM and AI-Powered Automation with Tableau

The goal has been to develop an implantable device that is safe and effective and can be programmed and adjusted by a remote-control device. Such devices would permit basal and bolus infusion therapy without frequent injections or indwelling transcutaneous needles. This would potentially improve quality of life[24] and minimize complications. Both intravenous and intraperitoneal delivery of insulin have been employed. Early versions of these devices were plagued by problems with fluid leakage into the system, short battery life, insulin blockage of the pump or catheter, and tissue blockage of the peritoneal catheters. With recent technologic advances, there has been a resurgence of interest in implantable pumps. The ideal implantable insulin pump[27] would respond to blood glucose levels in a continuous feedback fashion, forming a closed loop system. This would involve three components: a glucose sensor, an insulin delivery pump, and a computer controller that regulates insulin administration based on the measured glucose.

Closed loop systems require vascular access intravenously. Algorithms are employed to calculate the administered rate of insulin infusion from the existing glucose concentration. Several closed loop systems have been employed on an acute basis, but at present such devices are cumbersome and are not small enough for implantation. Another limitation of such devices is that insulin is given reactively. Normally, postprandial insulin levels increase before glucose levels. Several open loop implantable insulin pumps are undergoing clinical trials at the present time.

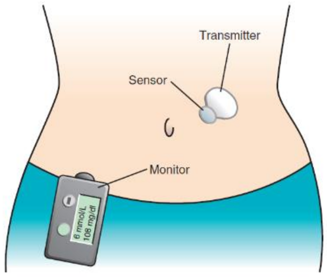

Figure 3: Representation of dispenser connectivity (sources)

Open loop systems consist of an implantable pump, a delivery catheter, and a patient–pump communicator. These pumps have several common features. They are all programmable and have batteries designed to provide approximately 3 years of service depending on the delivery rate. Depending on the model, a detachable catheter 9 to 15 cm in length with a free-floating tip is introduced into the abdominal cavity after subcutaneous placement of the pump. Silastic-coated polyethylene catheters may minimize insulin precipitation. The patient uses an external telemeter system to regulate a basal insulin infusion rate and preprogrammed boluses. The pump is refilled transcutaneously with a syringe every 4 to 12 weeks, depending on insulin requirements. The reservoir holds up to 6000 units of U-400 insulin. Pumps with side ports make flushing convenient, but they increase the incidence of hypoglycemia. We have taken into interest the diseases which have to be monitored constantly. As we know the person suffering from diabetes have to take immense care of their actions, their diet and their body's condition in order to keep the disease under control. The Dispenser is connected with a needle (which is replaced every 3 days) into the body and a glucometer which checks the glucose levels of the body and sends the signal to the insulin dispenser at regular intervals to keep the sugar levels under control. That is why we would have a tubeless insulin pump. This will be useful as it would minimize the need to inject insulin through syringes and also remove that tubing into the body. This will be done by making the insulin pump smaller and flat by using a microprocessor and making the insulin in form of smaller circular sachet. By increasing, decreasing or pausing insulin, the device aims to keep glucose levels from going too high or dropping too low. The smartphone app, meanwhile, includes a program for calculating bolus doses during meals.

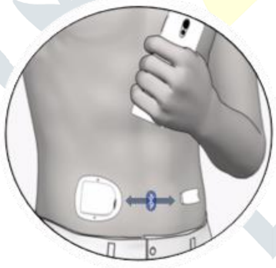

Figure 4: New modal without the tubing. (Sources)

Figure 5: Modal design (sources)

VA. The data processer Tableau and the Application (App)

The APP will consist of intelligent AI with help of data software like Tableau will Drive faster decisions with AI-powered predictions and recommendations We can get in-depth analytics on call times to identify cross-selling and upselling opportunities, increase conversions, and deepen customer relationships. and confidently act on predictions and prescriptive recommendations for better results. Automate repetitive tasks to provide a streamlined and personalized experience. which with the help of motion detectors in the phone, pulse checkers, and also check body temperature to check a person's state and once it detects sudden drop or rise in pulses and sudden loss of movement in the body it will immediately send an SOS to the nearest member of the family and alert the closest hospital [5]. This app is designed to overlay the details measured by the glucometer and the amount of insulin injected into the body and also the pulse rate of the body onto the mobile screen. The biosensors employed in applications such as disease monitoring, the management of chronic illnesses using continuous monitoring and connected medication administration is a revolutionary strategy that offers significant opportunities to enhance both patient quality of life and therapeutic results.

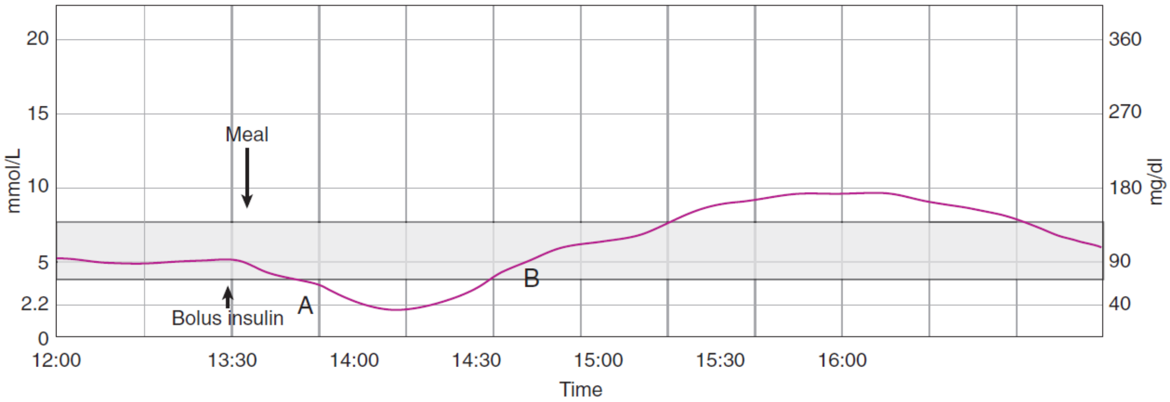

Figure 6: Graph of glucose to insulin release. (Source)

VB. Working of CGM and AI-Powered insulin dispenser.

AI[1] machine learning[31] is used in all three of the devices in the following ways. AI is used to analyse, understand, and then dispense the required amount of insulin by reading the glucose level at regular time intervals. CGM and AI-powered automation have brought major advancements in healthcare, providing patients with greater precision and convenience in managing their conditions. Continuous Glucose Monitoring[29] (CGM) uses sensors to monitor blood glucose levels throughout the day, alerting patients to any dangerous spikes or drops in real-time. This allows for more personalized and precise treatment plans, reducing the risk of complications such as hypoglycemia. Additionally, Artificial intelligence[30] powered automation streamlines the process of logging and analysing data from CGM devices, freeing up valuable time for patients to focus on their daily activities while making informed decisions about their health. These technological tools have transformed the way patients manage chronic conditions like diabetes, offering them improved accuracy, convenience, and peace of mind – all key factors in promoting long-term well-being. The tool seeks to prevent blood glucose levels from rising too high or falling too low by boosting, lowering, or halting insulin. Meanwhile, a method for calculating bolus dosages[4] during meals is included in the smartphone app.

VI. Patient knowledge-

Hospitalized patients and nurses[16] offered a range of opinions highlighting obstacles and adaptations to "striking the balance" in treating diabetes, even if patients wore their insulin pumps[10] They faced difficulties in utilizing these devices as effectively as feasible. Given that they can quickly plug in this automated dispenser and that artificial intelligence will reduce mistake and boost accuracy, patients and medical professionals won't have to worry as much about its use.[11] While they could have a knowledge gap, folks in remote and rural locations might easily grasp this capability.

VII. Our findings-

This development was designed to reduce the need for insulin injections, increase safety, and put safeguards in place to stop anything unwelcome from happening to someone's life. The most crucial element in creating an AI that is capable of functioning, clever enough to make the best choices, and minimizes the possibility of making mistakes.

VIII. Advantages over current treatment methods

The concept of utilizing an AI[2] algorithm and data processor, such as Tableau, with the insulin dispenser has been produced in order to make it feel and appear as natural and not create any extra pieces to carry about. It has also been made in order to keep it as basic and pleasant as possible. In the past ten years, there has been a sharp rise in the use of insulin pump treatment (continuous subcutaneous insulin infusion)[26] among young people with type 1 diabetes (T1D). In this study, we discuss the history of insulin basal rates and bolus dosages, as well as the benefits of pump therapy in conjunction with physical activity. In the context of pump treatment, acute complications of T1D (hypoglycemia and diabetic ketoacidosis) are examined. The benefits of pump treatment for patients in hospitals and in educational settings are explored. Lastly, the care of diabetes in the twenty-first century is discussed, including the possibility for a closed-loop pancreas and the use of pump therapy in conjunction with continuous glucose monitoring.

- Improved patient safety
- Real time alerts at the point of dispensing[3].
- Reduced dispensing mistakes.
- Dispensing is based on patient need at the point of care.
- Enabling dispensing to be carried out in real time
- Tracking of actual utilization.
- Increased accuracy in dispensing.
- Dispensing within the OR and Procedure Room tends to be more accurate.
- Increased security of controlled, high-risk medications.

IX. Future scope-

Health wearables like this act as an external pancreas-like device, simulating pancreatic function for the patient's benefit until a suitable new diabetes treatment[21] is discovered. In the future, illnesses affecting the other organs may likewise be treated, and external devices may even be able to mimic the organs' activities.

X. Conclusion-

For T1DM patients of all ages, insulin pump treatment has proven to be a great substitute for traditional injections. It gives enhanced management of blood sugar levels and lets the patient to have a more flexible lifestyle. The technology has advanced significantly since the first pump was released more than 35 years ago, and the pump market has expanded significantly along with it. These days, a lot of patients appreciate the comfort that insulin pumps offer. The next generation of "closed-loop" pumps ought to provide people with diabetes with even greater benefits.

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