A Comparative Study to Determine the Best Artificial Pancreas: Currently Available for Implantation

Ali Hussein Wanan	Department of Biomedical Engineering, College of Engineering, Thi-Qar University, Thiqar, Iraq
Anfal Hameed Nahai*	Department of Biomedical Engineering, College of Engineering, Thi-Qar University, Thiqar, Iraq
Fayhaa Laftah Taher	Department of Biomedical Engineering, College of Engineering, Thi-Qar University, Thiqar, Iraq
Malak Yousif Edweyir	Department of Biomedical Engineering, College of Engineering, Thi-Qar University, Thiqar, Iraq

Corresponding Author Email: anfalha98@gmail.com

ABSTRACT

The disease conditions that people suffer from, which caused disease, have been alleviated by the emergence of industrial treatment techniques, and this happened due to technological development. Many lives have been saved by the artificial pancreas technology. In addition, because the pancreas is important in the process of transplantation, it has become an industrial alternative for people who have type 1 diabetes. In this paper, we will discuss a comparative study of the types of pancreas. After mentioning an introduction to the pancreas transplantation, as well as an introduction to the history of an artificial pancreas in this paper. We talked about the types of artificial pancreas and presented the most important. Specifications for each type. We also made a recommendation on the best available ones that are suitable for everyday use. Finally, we looked at a prospective study on the possibility of developing an artificial pancreas.

Keywords: Artificial pancreas, Chronic diabetes, Pancreas failure, Pancreatic cancer, Control Algorithms.

1. Introduction

Chronic diabetes has huge social, health and economic consequences as it is a rapidly growing global problem. Globally, 285 million people suffer from this disease, due to estimates made in 2010 (about 6.4% of the population are considered adults). With no treatment or control, the incidence of this disease could rise to 430 million. There are two main reasons for the increase in the incidence of this disease and they are the aging population and obesity. In addition, it has been established that with presumed diabetes mellitus it is not diagnosed until 10 years after the onset of symptoms of the disease, their number is close to 50%, and astronomically speaking, global diabetes will be very prevalent [1].

In this research, we will discuss in detail about the artificial pancreas, by knowing first, what the natural pancreas of a healthy person consists of and what is the function of this important organ in controlling blood sugar levels through its secretions, as well as dealing with a group of diseases that affect this organ, the most important of which is pancreatic disease And then we deal with the artificial pancreas system since its first inception over the previous years and follow its development to the last development it reached and what is the effectiveness of this implanted organ inside the body and its usefulness for us and for all humanity, and then we take a future view of what research and experiments can produce an integrated device that overcomes Most of the challenges and problems that enable it to provide all means of comfort and satisfaction to the patient with one of the pancreatic diseases, and here we will explain a simple introduction to the basics of research.

Humans have constructed a device that resembles the pancreas' glucose regulating function, the artificial pancreas was the name given to this device. The goal of the device is to respond to changing blood sugar levels through the secretion of insulin. People with type 1 diabetes have used this device mainly to control glucose levels, as after eating, blood sugar rises in the true pancreas, and then the hormone insulin is secreted to move Sugar and blood flow between cells and it all happens when glucose rises and the pancreas senses it. So, at a later time it can be stored or used in the form of energy.

Another hormone glucagon is released when the blood sugar level drops and when the pancreas senses this so that the stored sugar is released in a stream by stimulating the liver to do so. Damage to the pancreas prevents people with type 1 diabetes from producing insulin. Since the pancreas is unable to manufacture insulin, the only way to manage blood sugar levels is by an externally administered insulin injection and frequent finger pricks. Now is the time to develop an externally injectable insulin system. Both doctors and patients become tired of the same repetitive procedures.

The Continuous Glucose Monitor (CGM), Transmitter (computer device/ phone), and Insulin Pump make up the Artificial Pancreas.

The insulin will talk to the CGM through the transmitter; the transmitter will then figure out how much insulin is needed in total and send a signal to the insulin pump to dole it out. To put it another way, the artificial pancreas device not only monitors the blood sugar but also automatically changes the amount of insulin that is pumped into the body to prevent hypoglycemia and bring down high blood sugar levels.

The system frees people by doing a blood test for sugar levels by pricking the finger several times a day, by daily continuous injections, insulin is given[2]. In type 1 diabetes when blood sugar is strictly controlled, this is important In the long-term, in order to prevent microvascular complications. Thus, an attempt is made to reach a normal blood sugar level by calling for intensive insulin therapy. Because of the increased risk of hypoglycemia associated with an intensive insulin regime, this has all proved to be a challenge. Glucose may be controlled through the provision of closed-loop systems, which are designed to provide an endocrine-like action to a healthy pancreas without human intervention. An integral part of the closed-loop system is signaled by a computer algorithm acting as an artificial pancreas. Other components include an infusion pump for the delivery of insulin. Calibration and continuous glucose monitor in real time.

The algorithm's job is to interpret the readings from the glucose monitor and determine the appropriate insulin dose to be supplied by the pump at any given moment. This review article describes the various parts of an artificial pancreas in order to emphasize the studies that have been done so far that provide clinical data for the various available models. Future directions for this technology are discussed with its existing constraints. Until a cure is discovered for type 1 diabetes, the use of an artificial pancreas can make daily life much more manageable by eliminating hypoglycemia and restoring normal blood sugar levels. The artificial pancreas is presently seen as a stopgap measure for the treatment of type 1 diabetes [1]

Methodology

We were able to complete this research through the following:

We wrote to universities specialized in this type of research, for example, Cambridge University, Thomas Jefferson University, University Teknologi MARA Shah Alam, and we benefited from many valuable information that guided us to develop an action plan on the topics and parts of the research. Through the published research on the topic of artificial pancreas, we read them with focus and accuracy. And we were able to take the information that helped us make a comparison between the types of artificial pancreas that currently exist.

We also entered into a discussion with several leading companies in the manufacture of this device, for example Medtronic,Beta Bionics, and we concluded from this discussion the best practical and useful type for patients with type 1 diabetes, and we developed several tips and instructions on choosing the right type of device for a patient with type 1 diabetes, and we dealt with several advantages for each type, the main and secondary parts of the device, and the method of implanting it inside the body.And by searching in international magazines and websites of well-known agencies, we were able to take a summary about this very useful device in improving the lives and reality of patients with diabetes who suffer from several problems because of it. and simplified.

1. Identification of Pancreas failure

Lack of insulin production is a common result of pancreatic dysfunction, which leads to uncontrolled blood glucose levels. The pancreas performs these and other crucial tasks. The inability of the body to turn sugar into energy is at the heart of diabetes, a disorder that can affect a large number of people even in the absence of blood sugar fluctuations (type 1). Type 1 diabetes and pancreatic failure have been linked to an autoimmune response in which insulin-producing cells in the pancreas are targeted by the body's immune system. Kidney disease can develop during this time frame because high blood sugar levels harm the kidneys' nephrons, which function as small filters. Scarring and renal failure are two of the potential outcomes. Transplants may be necessary in extreme cases of pancreatic failure when there is also severe chronic kidney disease (CKD) or end-stage renal disease (ESRD).

Consequently, many patients with pancreatic insufficiency have had a combined pancreas transplant because of the close connection between the two organs [2].

2. Acute Pancreatitis

The current definition of acute pancreatitis was developed during a consensus meeting on the topic that took place in 1984 in Marseilles. Widely used since 1992, this categorization was created in Atlanta after taking into account developments in the evaluation of illness severity, diagnostic imaging, and the three most crucial elements of the condition. Symptoms include dysfunction, a clinical condition, and structural damage. Abdominal pain that comes on suddenly and persists, together with abnormally high levels of certain pancreatic enzymes in the urine and blood, are diagnostic of acute pancreatitis. The majority of patients (about 85%) have a minor course of illness (edematous pancreatitis), during which the clinical symptoms totally vanish within a few days. For certain people, maybe as many as 15%, the disease worsens owing to organ malfunction (kidneys, lungs, the circulatory system of the automobile) (necrotizing pancreatitis).

3.1 Etiology

Gallstones and excessive alcohol use are responsible for 80-90% of all occurrences of acute pancreatitis. To clarify the etiology of the disease, it is helpful to distinguish between toxic metabolic, vascular, infectious, and mechanical causes. In a select number of individuals whose cases of acute pancreatitis cannot be traced to any particular cause, the diagnosis of idiopathic pancreatitis is made. An overabundance of alcoholic beverages, specific types of hyperlipidemia, the use of specific drugs, and hypercalcemia are all hazardous metabolic causes of acute pancreatitis.

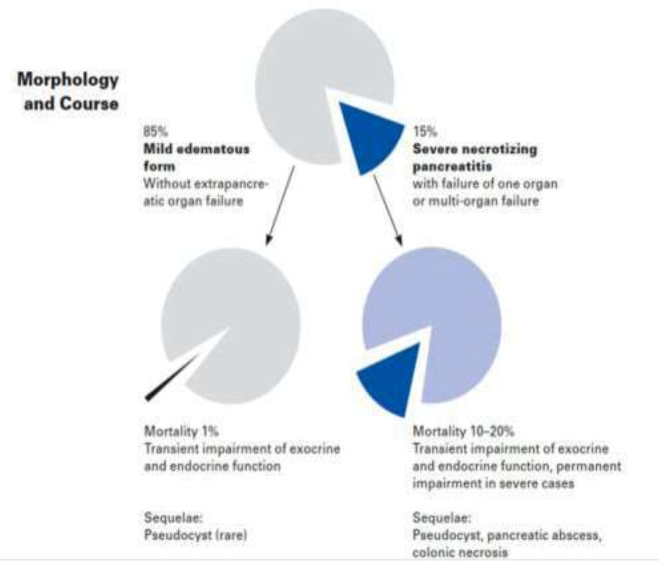

Figure (1): Morphology and Course in Acute


Figure(2): Pancreatic Abscess. **Figure (3): Postnecrotic Pancreatic Pseudocyst.**

3. Chronic Pancreatiti

Patients with chronic pancreatitis tend to show later than patients with acute pancreatitis, therefore age is often a clue, although clinical differences between the early manifestations of the two are sometimes impossible. The present description and classification of chronic pancreatitis, which center on the characterisation of morphological alterations, were used as the basis for consensus conferences conducted in Marseilles and Cambridge in 1984. Repeated attacks of severe abdominal pain, or epigastric pain, are a hallmark of chronic pancreatitis. Continuous, chronic pain with no exacerbations in a minority of patients; a pain-free minority of individuals; initial clinical presentation characterized by diabetes and clinical diarrhea. An uneven and variable fibrosis distribution, caused by fever's exterior secretions, is a morphological feature of chronic pancreatitis [3]

4. Diabetes Mellitus

Diabetic mellitus (DM), or just diabetes, is a set of metabolic illnesses characterized by persistently elevated blood sugar levels.

High blood sugar causes dry mouth, hunger, and urine that occurs more often. Many issues can arise from diabetes if it is not addressed. Diabetic ketoacidosis and non-ketogenic hyperosmolar coma are examples of extremely dangerous consequences. Serious problems have long-lasting effects and include stroke, heart disease, foot ulcers, vision damage, and kidney failure. The inability or failure of the pancreas to generate enough insulin is the root cause of diabetes.

In general, there are three distinct forms of diabetes mellitus:

Diabetes type 1 is brought on by an inability to produce enough insulin. Insulin-dependent diabetes mellitus (IDDM) or juvenile diabetes was an earlier name for this condition. No one knows why this is happening. Type 2 diabetes mellitus is characterized by abnormal insulin response due to cellular dysfunction, and this abnormality is due to insulin resistance. Insulin deficiency may develop as the disease progresses.

Non-Insulin-Dependent Diabetes Mellitus (NIDDM)., often known as adult-onset diabetes, is the most common type of diabetes Lack of physical exercise and excessive body fat are the primary causes of Type 2 diabetes. Gestational diabetes is the third most common kind of diabetes, and it is more likely to occur in women who have never had diabetes before during pregnancy [4].

5. Pancreatic cancer

There are around 53,680 new cases of pancreatic cancer diagnosed in the US each year.

Most cases of pancreatic cancer occur in patients who have no known risk factors for the disease.

Age, however, may be the most significant risk factor; the individual faces a greater danger beyond the age of sixty. Familial genetic mutations, such as the BRCA-2 and, to a lesser degree, the BRCA1 mutations, place individuals at a higher risk, as do sporadic mutations. Although familial syndromes are extremely rare, it is essential to inform your doctor if you or a member of your family has ever been diagnosed with cancer, especially pancreatic cancer. The chance of developing pancreatic cancer may also be somewhat raised by a number of health problems and ways of living.

People having a history of pancreatic cancer in their families or who are African American are at a higher risk.

Those who are overweight, have a family history of diabetes, smoke cigarettes, are not physically active, have a high-fat diet, or suffer from chronic pancreatitis may also be at an increased risk. Consequences of chronic infections, including hepatitis B and H. pylori, and previous stomach surgery may enhance one's risk moderately (a bacterial infection of the stomach lining) [5].

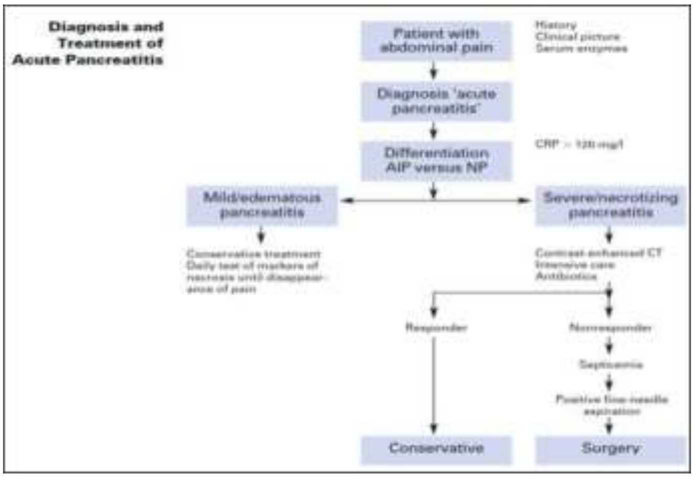

Figure (4): Acute Pancreatitis: Diagnosis and Treatment.

6. Cases of Patients:

6.1 Case of Acute Pancreatitis

40-year-old married mother of one, professional office administrator

History

The patient was hospitalized to a hospital on the periphery in a state of shock due to excessive alcohol intake; the patient had a history of alcoholism. The patient has been experiencing severe abdomen discomfort for the last 42 hours. The patient's rapid clinical deterioration and the diagnosis of acute severe pancreatitis necessitating artificial breathing prompted the referring institution to transfer the patient.

Findings

The patient had tachypnea, tachycardia, hypotension, and lethargy. Abdomen is notably bloated and tympanitic. Weight of 103 kg (226 lb) and height of 175 cm (5 ft 9 in). Temperature (rectal) of the body is 38.9°C, heart rate is 132/min, and blood pressure is 95/55 mmHg. Hemoglobin 11.2 g/dl; leukocytes 16.5 109/l; INR –2.1; amylase 1,405 U/l; lipase 1,896 U/l; AST 29 U/l; -GT 115 U/l; creatinine 3.1 mg/dl; calcium 7.6 mg/dl; blood sugar 312 mg/dl; CRP 347 mg/l; blood gas analysis: pO2 62.

Transabdominal Ultrasonography

Fatty liver and cholelithiasis are present. Since the intestines tend to cover each other up very well, it's hard to make out the pancreatic area.

Contrast-Enhanced CT

Acute necrotizing pancreatitis was present, as indicated by necrosis of about half the pancreas, most noticeably in the body and head, and normal perfusion in the pancreatic tail. Necrosis of the pancreas that spreads to the area behind the bowels on both the left and right. is a fluid that is contained inside the abdomen but is not confined there. Ileus symptoms present, including enlarged small and large bowel loops.

The Diagnosis

Pancreatitis was necrotizing with multi-organ failure (cardiovascular, pulmonary, renal, cerebral, coagulation).

The Management

Transfer to the ICU.

Course

A controlled mechanical ventilation intubation was performed on the patient, using a FiO2 of 80% and a PEEP of 10 mmHg. According to the CVP, conservative treatment included continuing NPO, nasogastric intubation, bladder catheterization, and IVF.

initiation of exogenous insulin therapy, TPN, and preventive intravenous antibacterial therapy with imipenem and cilastatin. Furosemide 200 mg/24 hours was also administered in addition to increasing the crystalline infusion solutions for oliguria from the initial 6 liters/24 hours. Low dosage dopamine (1-4 g/kg/min) was added to treat hypotension while norepinephrine (7 g/kg/min) was given to treat hypotension. Over the first two weeks, the patient's condition stabilized, but on day 18, sepsis-related cardiovascular deterioration happened. With FNA, a specimen of peripancreatic fluid was taken along with a CT. Gram stain identified gram-negative microbes, and subsequent culture indicated the presence of Candida, Proteus, and Escherichia coli. Pancreatic and retroperitoneal necrosis are removed during laparotomy.

No longer necessary: insulin therapy. Up to 39°C temperatures and increased inflammatory markers appeared 2 weeks later. On the right, a retrocolic fluid accumulation (abscess) was visible on a CT scan. Percutaneous interventional drainage was performed that same session. 10 days later, the abscess drainage catheter was removed. After 56 days, discharge. Over the next two months, a pancreatic fistula with up to 50 ml/day gradually diminished and stopped.

Case Record

History	Transfer to referral hospital	
Diagnosis	Acute pancreatitis	
Etiology	Alcohol	
Laboratory findings	Hemoglobin 11.2 g/dl, leukocytes 16.5×10^{9}/l, amylase 1,405 U/l, creatinine 3.1 mg/dl, calcium 7.6 mg/dl, blood sugar 312 mg/dl, INR ~2.1, CRP 347 mg/l, blood gas analysis: pO_2 62 mm Hg on 6 liters O_2/min, pH 7.3, pCO_2 31.4 mm Hg, base excess −11	
CT	Pancreatic necrosis (50%) and extensive peripancreatic necrosis	
Staging	Necrotizing pancreatitis	
Treatment	ICU Mechanical ventilation	Prophylactic antibiotics
Surgery	Necrosectomy and retroperitoneal lavage	
Course	Interventional abscess drainage, spontaneous closure of a persistent pancreatic fistula after 2 months, decreasing insulin requirements	
Prognosis	Good, recovery of pancreatic function	

Table (1): Case 1 Record [5]

The term "artificial pancreas" describes a number of advanced closed-loop medical devices that automate the administration of insulin to type-1 diabetics. On the one hand, they promise to lessen the ongoing difficulty of controlling type 1 diabetes. On the other hand, they expose the patient to the potentially fatal effects of improper insulin delivery, which might result in coma or even death in the near term or long-term damage to vital organs including the heart, kidneys, and eyes. A thorough modeling of human physiology, the medical device, and the surrounding disturbances at the appropriate level of abstraction is required to confirm the accuracy of these devices.

7. Identification of Artificial Pancreas

From values collected by the CMG, the AP employs a mathematical control technique to autonomously modify insulin infusion. Various strategies, such as systems that simply use insulin infusion and systems that combine insulin infusion, are currently being researched. glucagon infusion is used. To improve glycemic control, a new technology known as the artificial pancreas (AP) or closed loop control (CLC) has been created recently. A CGM device, an insulin pump (and, if necessary, a glucagon pump), and a control algorithm make up the current (APS). The control algorithm is the system's brain, and various algorithms are employed by various groups to drive the infusion of insulin. Model predictive control (MPC), proportional-integral derivative (PID) control, and fuzzy logic control are the three control techniques that have been utilized thus far.

1. Closed-loop artificial pancreas. 2. Bionic pancreas. 3. Implanted artificial pancreas.

7.1. Closed-loop artificial pancreas:

One type of artificial pancreas that has undergone extensive testing is a "closed- loop insulin delivery system," sometimes known as a closed loop artificial pancreas. An insulin pump is worn on the outside of the body and communicates with a continuous glucose monitor (CGM) worn as a skin patch through wireless technology. The continuous glucose monitor (CGM) reads the patient's blood sugar levels and transmits that data to a small computer, which then determines whether or not to activate the insulin pump. When the dosage is given to a living organism, the cycle is completed.

7.2. The bionic pancreas:

Beta Bionics, founded by Dr. Edward Damiano, is responsible for developing this system, which comprises of two insulin pumps that provide insulin and glucagon, respectively. The pumps pair through Bluetooth with a mobile app on an iPhone, facilitating two-way communication and facilitating the determination of appropriate dosages. Automated decisions regarding insulin and glucagon dosing are made every five minutes based on data from the continuous glucose monitor (CGM).

7.3. Implanted artificial pancreas:

The implanted insulin delivery system uses a gel created by De Montfort University researchers. The gel increases the pace at which insulin is released when blood sugar levels are high and decreases the quantity of insulin released when blood sugar levels are low. The implanted system could receive regular insulin refills [6].

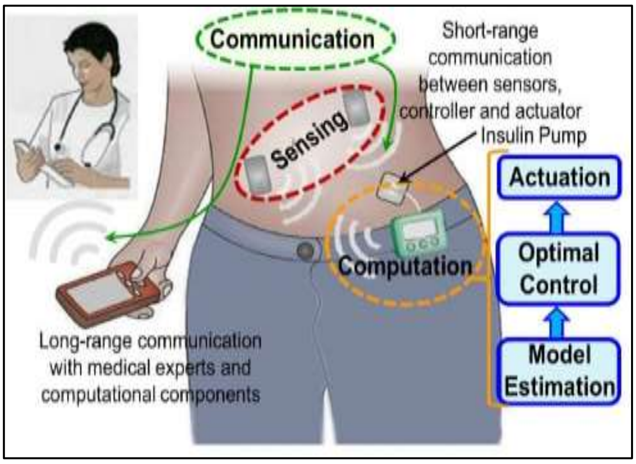

Figure (5): Principal of AP. [6]

8. Control Algorithms

MPC

In order to predict future blood glucose levels based on current glucose levels, glucose trends, and the insulin already provided, the MPC algorithm use mathematical models. When new glucose measurements and a new future glucose forecast are made available, MPC can change the way it administers insulin based on these predictions every few minutes.

PID

The integral component of the PID algorithm takes into account the area under the curve between ambient and target blood glucose, the PMPOATIONAL component, and the rate of change of the patient's blood glucose to constantly alter insulin infusion rates (the derivative component). The key distinction between this algorithm and MPC is that the latter can be thought of as proactive while the former is only reactive.

Fuzzy Logic

This algorithm attempts to mimic medical decision-making by taking into account the specific treatment characteristics of each patient and modifying insulin delivery based on approximations of rules established from empirical knowledge amassed by diabetic practitioners. [7]

9. Continuous Glucose Monitor safety

Correct glucose levels are crucial to the safety and effectiveness of the artificial pancreas. The artificial pancreas system needs a constant glucose monitor because control algorithms require constant glucose input. Subcutaneous enzyme glucose sensors with a linked transmitter for wireless data transfer are now the only suitable innovative technology despite the development of several other technologies such as implanted glucose sensors. These sensors produce a current that is proportional to the local glucose concentration; this current is then calibrated to provide an approximate estimate of blood glucose. Enzyme glucose sensors continue to improve in accuracy and reliability, but they are still not approved for use as a blood glucose reference for insulin administration. The sensor under readings increases the risk of hyperglycemia, whereas large positive sensor deviations from the true glucose levels increase the risk of hypoglycemia owing to improper insulin dosing. When glucagon injection was delayed because of positive sensor aberrations, it was less effective at preventing hypoglycemia in research using a bi-hormonal artificial pancreas. It's crucial to keep in mind that the data produced by continuous glucose monitors is a time series, not a collection of numbers. Studies have shown that the mean absolute relative difference (MARD) analysis between sensor glucose values and paired reference glucose values is an underestimation of the amount of meaningful information contained in glucose sensor data, yet MARD analysis is commonly used to evaluate glucose sensor accuracy. Here are some suggestions of our own for minimizing the effects of calibration error: One might (1) only calibrate in conditions of euglycemia and steady glucose measurements; (2) only enable calibration under these conditions; or (3) at the very least, alert the user of the likelihood of a calibration mistake. Since SMBGs are prone to the device- and user-related faults that degrade sensor accuracy, the first step is strongly advised. A sensor's accuracy may drop after being calibrated using an SMBG, even though it was adequate before. It is not necessary to re-calibrate the sensor or the SMBG if the measurements are within the range of uncertainty associated with either.

If the sensor value and SMBG are different, a second or third SMBG must be acquired to lessen the likelihood that an incorrect SMBG is utilized for calibration [8].

10. The future of Artificial pancreas

Algorithms presented in this issue are sensitive to a wide range of observable variables, including insulin pharmaco-kinetics, meal timing and carbohydrate appearance, meal size, exercise intensity, stress, day-to-day variations in insulin sensitivity, insulin time-activity profiles, the precision with which glucose monitors can calibrate, metabolic profiles for both adults and neonates, and the risks of hypoglycemia and hyperglycemia. These articles present theoretical advances in insulin delivery algorithms based on simulated individuals, in addition to clinical data from actual patients who have used closed loop devices. Thanks to the novel concepts provided in these articles[9], we should be much closer to developing a commercially feasible closed loop system for regulating glucose levels in diabetic patients.

multi-population studies Children and teenagers, adults, mixed groups of children and adults, and animals are the key demographic groups employed in these investigations. There is now a model-predictive control, monitoring study taking place with 19 patients who have had Type 1 diabetes for an average of 6.4 years at the Wellcome Trust Clinical Research Facility at Addenbrooke's Hospital in Cambridge, UK (Hovorka et al, 2010). This study employs a manual closed-loop method since a nurse's assistance is required for insulin pump regulation during the glucose measurement job. In order to reduce the occurrence of both hypoglycemia (low blood sugar) and hyperglycemia (high blood sugar), a closed-loop insulin delivery device is employed in this research (hyperglycaemia).

The research also shows that glucose control may be greatly improved in young people with Type 1 Diabetes by using manual closed-loop insulin administration at night. I Analysis of the benefits and drawbacks of insulin pump treatment and the use of an artificial pancreas Adults with Type 1 diabetes are now participating in the nocturnal closed loop insulin administration trial, in addition to children and adolescents. The trial was led by Hovorka and his colleagues (Hovorka et al, 2011). They compared the efficacy and security of artificial pancreas technologies to those of conventional insulin pump treatment. In order to see how drinking impacted the study, alcoholic beverages were consumed at various points during the investigation. The different sizes of the evening meals consumed by each patient were the main variables in this investigation.

10.1. Expectations Are Paramount

The acceptance and continuation of AP therapy depend critically on realistic expectations, which are thankfully within the clinician's power to change. The most straightforward theoretical example of the predictive power of expectations is the technology acceptance model (TAM). The theory of reasoned action, a well-known psychological and behavioral theory that helped to explain volitional human conduct including voting, exercising, and condom use, served as the intellectual foundation for the TAM's development 30 years ago. These ideas were converted by Davis and colleagues into a technology-centric model that has been adopted and used in a variety of fields, including information technology, e-commerce, health research, and medicine.

10.2. Mismatched Expectations with AP

Just as there is no "one size fits all" approach to diabetes care, AP systems are not the best option for all T1D patients. Patients who are convinced to use AP based on exaggerated claims about its usefulness and simplicity may become dissatisfied with the product if it falls short of their expectations. The therapeutic management of T1D is disrupted when AP is discontinued out of frustration, costing patients' time, money, and peace of mind in addition to precious professional resources. The majority of this can be prevented by improving AP comprehension prior to device initiation.

10.3.Engineering Professor's Patent Advances a Next-Generation Artificial Pancreas System

Beyond what is possible using conventional approaches, artificial pancreas technology has the potential to significantly enhance the daily lives of persons with Type 1 diabetes. The next generation of technology will further develop artificial pancreas systems thanks to new research led by Ali Cinar, professor of chemical engineering at Illinois Institute of Technology. The research also introduces a novel method for monitoring and controlling the blood glucose levels of diabetics.

10.4. Algorithm Development

the industry because 2007. Since then, there has been significant progress, including the creation of an in-silico diabetes simulator for algorithm testing. 6 The Food and Drug Administration (FDA) has approved the use of this simulator by several researchers as a tool for computer-aided development of control algorithms as a preclinical alternative to animal testing. This year's symposium essays concentrate on algorithms, which are now more than ever subject to a wide range of influences.

Numerous measurable factors, such as insulin pharmacokinetics, meal timing and carbohydrate appearance, meal size, exercise level, stress level, daily variations in insulin sensitivity, insulin time activity profiles, accuracy of glucose monitor calibration, metabolic profiles of both adults and neonates, and risks of hypoglycemia and hyperglycemia, affect the algorithms presented in this issue. This symposium presents clinical evidence from genuine patients who have employed closed loop systems in addition to theoretical advancements in insulin administration algorithms from modeled in silico patients[9].

11. LOOKING TO THE FUTURE

Performance and user experience are likely to be improved by changes to closed-loop system components. Device load will be decreased by noncalibrating continuous glucose monitoring devices with improved accuracy and longer wear times, as well as algorithms built into insulin pumps or available as a smartphone app. A JDRF initiative to speed up regulatory approval of interoperable devices has allowed the flexibility to select various combinations of "open protocol" devices for automated insulin delivery, which allow smooth and secure interaction with other devices.

The transition from hybrid closed-loop systems requiring prandial boluses to fully automated systems may be facilitated by ultrafast-acting insulin analogs or adjuncts that lower postprandial glucose responses. In contrast to sensor glucose input alone, algorithms incorporating various data, such as activity measures, may more precisely represent quickly varying insulin requirements.

Closed-loop control will probably become more appealing and acceptable as a result of remote monitoring systems (like Dexcom Share, for instance, which allows glucose data sharing among chosen individuals). In order to promote the best possible use of this technology, data management tools like Diasend/Glooko will be crucial for making data from closed loop systems easily accessible to consumers and healthcare professionals. Clinical trials that apply closed-loop to specific cohorts of people with type 1 diabetes will be crucial in identifying those who can profit the most from this technology and in providing vital supporting data for health care providers' compensation.

Figure (6): the last version Medtronic's New 770. [9]

CONCLUSION

We Group prefer providing small, easy-to-use and accurate technology so that people with type 1 diabetes (T1D) can go about their day without having to check blood sugar levels or insulin dose too often. It also enables open systems and advances the algorithm to automatically control blood sugar, even while eating or exercising delivers insulin as a result of its readings. The artificial pancreas must be chosen, which has high durability and accuracy in measuring blood sugar levels, and injects an appropriate and sufficient amount of insulin to the body. It must have a battery that works for a long time and with stable efficiency and safe and Improved metabolic control andHypoglycemia can be lessened.secretions of the pancreas and maintaining blood sugar levels without any sudden or harmful problems that may lead to the patient’s life or reduce his activity and his health and psychological stability,and in last we prefer used type Bionic pancreas because of automatically controls blood glucose levels, comprising two insulin pumps which deliver and insulin and glucagon respectively.

REFRENCES

[1] H Thabit MD,R Hovorka PhD,M Evans MD , "Artificial pancreas: the bridge to a cure for type 1 diabetes", European Diabetes Nursing.03 October 2012. 56-60.

[2] Group of researchers at Tampa General Hospital, "History of pancreas" , Tampa General Hospital,2001.

[3] Büchler , Uhl , Malfertheiner , Sarr " Diseases of the Pancreas", 168 figures, including 36 fourcolor prints, and 87 tables, 2004.

[4] International Diabetes Federation, "Diabetes Blue Circle Symbol", 17 March 2006.

[5] Francis W. Nugent, MD. Keith E. Stuart, MD. Charles Patrick Davis, MD, PhD ,"Pancreatic Cancer" ,2019.

[6] Group of Diabetes researchers ,"Artificial Pancreas", 15th January 2019.

[7] Ch.mo Prof. Annalisa Angelini , Ch.mo Prof. Angelo Avogaro , " Ificial Pancreas development in type 1 Diabetic Patients" , University of Padova Department of Cardiac, Thoracic and Vascular Science ,2001.

[8] Helga Blauw , 1,2 Patrick Keith-Hynes, 3,4 Robin Koops, 2 and J. Hans Devries1 1," Diabetes ", Department of Endocrinology, Academic Medical Center, University of Amsterdam, P.O Box 22660, 1100 DD Amsterdam, The Netherlands; 2 Inreda Diabetic BV, Goor, The Netherlands; 3 TypeZero Technologies, LLC, Charlottesville, VA, USA; and 4 Center for Diabetes Technology, University of Virginia, Charlottesville, VA, USA (Received 19 April 2016; accepted 13 June 2016).

[9] Progress in Development of an Artificial Pancreas/Written by :David C. Klonoff,Claudio Cobelli,Howard C. Zisser./Journal of diabetes science and technology (Online)/Diabetes Technology Society

[10] AN OVERVIEW OF RECENT DEVELOPMENT ON ARTIFICIAL PANCREAS *Nur Farhana Mohd Yusof, Ayub Md. Som Faculty of Chemical Engineering ,Universiti Teknologi MARA Shah Alam 40450 Shah Alam , Selangor.