Winter 2017

Diabetes Mellitus: Concerns, Treatment Options, and the Future

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Introduction:

According to the Center of Disease Control (CDC), twenty-nine million people in the United States were said to have diabetes in 2014. This equates to one out of every eleven individuals having diabetes. Consequently, one out of every four people do not know they have diabetes (CDC 2014). A study conducted by David Nathan, professor of medicine at Massachusetts General Hospital, mentions that "more than 80 million people are considered to be at high risk of developing it [diabetes]. Worldwide, more than 350 million people are estimated to have type two diabetes" (Nathan 2015). Diabetes has been an epidemic that has been present worldwide for many years. The amount of people that are being diagnosed with diabetes, especially type two diabetes, has drastically increased in recent years. According to an article released by the *Huffington Post* in 2013, 382 million people in the world were living with diabetes. The article also goes on to say that approximately forty-six percent of the population is undiagnosed. Comparing the amount of people that were said to have diabetes in 2014 and the amount of people estimated to have cancer of any type in 2013 is eye-opening. According to the National Cancer Institute, "In 2013, there were an estimated 14,140,354 people living with cancer of any site in the United States" (Cancer Stats Facts). According to a study conducted by Javier Escalada, an affiliate of the University of Narvarra, in Pamplona, Spain, "Diabetes is currently among the top five causes of death in most high-income countries and resulted in 4.6 million deaths globally in 2011. The prevalence of diabetes, particularly type two (T2DM), continues to grow at an unprecedented rate. In 2011, 360 million persons had diabetes, of which 95% have T2DM. In 2030, there will be approximately 552 million people with diabetes" (2016). A quick Google search with the term 'diabetes' results in 262,000,000 different sites or articles that pertain to diabetes. Diabetes is a disease that many people know about generally speaking, but the details are unknown to most people. The cost

associated with having diabetes is another reason why it is of much concern. An article written by the *Huffington Post* in 2013 says that the world spent 548 billion dollars on diabetes health care -- 11 percent of the total spent for health care worldwide. In the United States alone, 245 billion dollars were spent on diabetes during that year. After adjusting for population, age and sex differences, average medical expenditures among people with diagnosed diabetes were 2.3 times higher than what expenditures would be in the absence of diabetes. The article also states that, if diabetes continues to increase at the rate it is, by 2035 the percentage of people with diabetes will increase by 55% (2013). These very overwhelming and serious statistics show the necessity of a close review of type two diabetes and where future research is going. This review intends to investigate diabetes through its history, the genetics behind the disease, the physiology of insulin in the body, the different treatment options for diabetes, the monetary concerns, and by an analysis of the future, to shed light on how diabetes is a very serious disease that needs to be on the forefront of medicine.

What is Diabetes?:

Diabetes is a metabolic disorder secondary to a deficiency of insulin secretion or insulin resistance. This accounts for type one and type two diabetes, respectively. Common symptoms that people experience with diabetes are polyuria (increased urination), polydipsia (increased thirst), and weight loss (Papadakis 2016). The pancreas, the organ that produces insulin, facilitates the regulation of blood sugar. Type one diabetics do not have sufficient secretion of insulin because of a mutation of the pancreatic genes (Bratman 2007). Type two diabetics have a resistance to insulin. Their bodies still produce insulin, but not at as quick of a rate, and their bodies are not as receptive to the hormone (American Diabetes Association). Diabetes, if left untreated, "results in relatively specific long-term complications affecting the eyes, kidneys, and peripheral and

autonomic nervous systems, accounting for more adult cases of vision loss, end-stage kidney disease, and amputation than any other disease" (Nathan 2015). Diabetes is a disease that becoming an epidemic. Public health officials are labeling this as a crisis because of the severity of the disease if left untreated.

History:

The history of diabetes is extensive, which is well documented by the American Diabetes Association. The history of diabetes dates back to 1425 when it was first seen in the English language. The next mention of diabetes following its start in 1425, was in 1910 when an English physiologist named Sir Edward Sharpey-Schafer coined the term insulin following a study he conducted on the pancreas. The term *insulin* comes from the Latin "insula", which means *island*. This referenced the insulin-producing islets of Langerhans in the pancreas. A few years later, in 1915, the only treatment option for treating diabetes was released: severe calorie restrictions. Scientists knew that there was a lack of insulin production, but it was unknown how to give people with diabetes the necessary insulin to counteract hyperglycemic episodes. A year later, *The Treatment of Diabetes Mellitus* was published by Elliot Joslin, MD, a clinician and an educator that is known as one of the most influential voices in diabetes care. In 1921, Frederick Banting, MD, along with a student assistant, Charles Best, MD, extracted insulin from the pancreas of a dog. They then injected the insulin into dogs whose pancreases had been removed and saw that the dogs' blood glucose levels decreased. This prompted the purification of insulin so that it could be used in humans, done by James Collip, department chair of biochemistry at McGill University. In 1922, a year after it was discovered that insulin lowers blood glucose levels, insulin was injected for the first time into a human. Diabetic teenager Leonard Thompson was the individual that received the injection. He improved dramatically, supporting the claim that insulin lowers blood

glucose levels. With this supported evidence, the commercial production of insulin began in 1923 by Eli Lilly and Company. In 1936, the mechanism to prolong insulin effects was discovered by Novo Nordisk owner Hans Hagedorn. By adding protamine to the insulin, the effects were lengthened. The lengthened effects of insulin is what diabetics are treated with to manage every-day diabetes regulation (American Diabetes Association).

Thirty years after the term insulin was coined, the American Diabetes Association was founded because of the increasing incidence of diabetes and the complications developed from the disease. A year after the creation of the American Diabetes Association, the first scientific session on diabetes was held in Cleveland, Ohio. This session, now an annual meeting, began the research process for diabetes. In 1946, the National School Lunch Act was signed by President Truman. This act improved nutrition standards, ensuring healthy meals and snacks in schools. This act was intended for more than just diabetes prevention. There were multiple uses and functions of the act, but it is greatly applicable to the history and progression of diabetes management and treatment. Three years following the enactment of the School Lunch Act, the mechanism of insulin was discovered by Dr. Rachmiel Levine. He discovered that insulin "works like a key". What he meant by this was that insulin opens the door to transport glucose into cells. His discovery eventually led to new medications that treat type two diabetes. With more and more knowledge being obtained about glucose consumption, the American Diabetes Association, the American Dietetic Association, and the U.S. Public Health Service created a meal plan in 1950 that divided foods into six groups based on the calories, carbohydrates, proteins, and fats in each serving of food. With more research, the first oral medication became available in 1955, sulfonylureas. This medication stimulated the pancreas to release more insulin. It was not until 1959 that the distinct types of diabetes were identified. Drs. Berson and Yalow developed a method for measuring

insulin in the blood. They noticed that some people with diabetes still made their own insulin, to which the two distinct types of diabetes were formed. In 1971, researchers discovered insulin receptors on cell membranes. This discovery supported the idea that missing or defective receptors could prevent glucose from entering the cells, thus contributing to the insulin sensitivity of type two diabetes. Hypoglycemia, or low blood sugar, can cause severe effects if not treated. To treat severe hypoglycemia, Eli Lilly and Company released glucagon in 1961, a hormone produced by the pancreas to raise glucose levels (American Diabetes Association).

It was not until 1966 that the first successful pancreas transplant was performed. This surgery, performed at the University of Minnesota, was the first "effective" cure for diabetes. Although there is the risk of rejection from the donor pancreas, for many people this was a way to win the lifelong battle against diabetes. In 1978, the first medical infusion pumps were invented, which allowed insulin to be delivered to the body without the use of a syringe. It was not for another sixteen years that Metformin, a drug used to treat type two diabetes was introduced to the market. Two years following the release of Metformin, Acarbose was introduced as the first alpha glucosidase inhibitor. A study published in the *New England Journal of Medicine* reports that, in 2014, the incidence of diabetic complications have dramatically improved as a result of research advances and preventative care of the course of 20 years. The study showed a 52.9% reduction in stroke; 67.8% reduction in acute myocardial infarction; 51.4% reduction in amputation; 28.3% reduction in end stage renal disease and 64.4% reduction in hyperglycemic crisis deaths **(**American Diabetes Association**)**. The history of diabetes is extensive and it is still being added to. The history will continue to grow until new discoveries are found, until the entire population understands the severity of this disease, and until the countless type two diabetics start to adjust their lifestyle choices.

Genetics of Diabetes:

It is widely known that our genetics make up who we are as human beings. Genetics provide the make-up for every single organism on this planet. Genetics is not widely discussed or talked about until a disease or problem is discovered or until it worsens. This is what happened with diabetes. People questioned how a baby just born into this world could have this disease. This led to countless research studies about the genetics behind diabetes. A study conducted by Ewan Pearson, from Ninewells Hospital & Medical School in the United Kingdom says that there are a large number of causes of monogenic diabetes accounting for approximately 5% of diabetic cases (2008). He notes that "in the last decade, there has been a great leap forward in our understanding of genetic forms of diabetes, how genetic variation predisposes to type one and type two diabetes, and how genetic testing can start to play a role in the outpatient management of diabetes." Because monogenic diabetes is so rare, there are three key reasons, according to Pearson, why it is important to recognize and diagnose these forms of diabetes. The first reason is because diabetes is usually inherited in a dominant Mendelian manner. This allows family members to have predictive genetic testing allowing for early detection of diabetes. Secondly, "knowing the precise cause provides insight into how an individual's diabetes will progress, and what associated abnormalities should be screened for." The last reason is because recent work has identified how understanding the etiology of a patient's diabetes can impact their therapeutic management. There are, however, a few causes due to monogenic disorders or insulin action. Some include mutations of the *PPARG* and *AKT2* genes. A *PPARG* mutation or deletion causes insulin resistance, which can affect both type one diabetics and type two diabetics (Le et. al 2003). An *AKT2* deficiency shows an "impaired ability of insulin to lower blood glucose because of defects in the action of the hormone on liver and skeletal muscle" (Cho et. al 2001). A vast majority of cases, however, are characterized by

beta-cell dysfunction. A study published in the *Alimentary Pharmacology and Therapeutics* Journal concludes that "Insulin resistance is almost certainly the result of a complex interaction of environmental/acquired factors and genetic factors. Further studies are needed to elucidate the respective role of these components in the expression of insulin resistance and type two diabetes" (Carulli 2005).

Monogenic cases accounts for only 5% of diabetic cases. This does not account for the 95% of the population with type one or type two diabetes. Type two diabetes is said to be multifactorial. This is because of common variations between genes, environmental factors like obesity, and the yet undiscovered 'viral triggers' for type one diabetes (Pearson 2008). Up until the early 2000s, the genetics behind diabetes was unknown. There is still a lot that is unknown about the disease, but with the number of studies that are being conducted, researchers are furthering the understanding behind this mysterious disease.

Physiology of Insulin in the Body:

As we eat food, our bodies break down the food into usable energy and nutrients. The usable energy is in the form of glucose. When there is an influx of glucose in the body, the blood glucose levels increase. According to WebMD, target blood sugar should be between 100 and 160 mg/dL (WebMD). Blood sugars that are unregulated can cause serious effects, even death. Because of this, our bodies have a natural mechanism to counteract the elevated glucose levels. When glucose enters the bloodstream, it comes across the beta islet cells of the pancreas. On the cell membrane is a protein carrier channel, called GLUT 2. This channel ushers glucose into the beta cells and creates ATP, while allowing the release of insulin into the blood stream. From there, insulin can bind to the insulin receptors on the liver, adipocytes, and muscle tissues. This also will

facilitate glucose absorption. An interesting thought is that once glucose enters the adipocytes, it is transformed into triglycerides. When the body tries to break down fats, it starts with the degradation of triglycerides. This forms fatty acids. This is a slower mechanism to obtain energy that is needed to fuel the body because fat does not make as much ATP. People that are type two diabetic have an insensitivity to insulin, which forces triglycerides to remain in the adipocytes. This could be a cause for why many type two diabetics are obese (Silverthorn et. al 2013). The mechanism for insulin secretion and glucose absorption is hindered or non-functional for diabetics. This is problematic because the insulin, glucose mechanism is supposed to work without flaw to ensure a proper regulation of blood glucose levels.

Treatment Options:

Because diabetes is such a serious and critical disease, many treatment options have been developed to treat episodes of hyperglycemia or to simply manage diabetes mellitus. One drug that is commonly used is Metformin, commonly known as Glucophage. According a study from the *Journal of Clinical Investigation*, "metformin is widely used for the therapy of type two diabetes mellitus. Metformin ameliorates hyperglycemia without stimulating insulin secretion, promoting weight gain, or causing hypoglycemia" (Zhou 2001). Interestingly enough, the mechanism on how metformin works is still an enigma. What is known about this drug is that it increases skeletal myocyte glucose uptake while decreasing hepatic glucose production. However, with any drug, there are side effects. In the case of metformin, some common side effects are nausea, vomiting, weakness, and a metallic taste in the mouth. A more severe side effect can occur when first starting to take the drug. If stomach issues present, it could be a sign of lactic acidosis (WebMD). Metformin is a low-potency compound that "is used at high doses, resulting in only modest net efficacy" (Zhou 2011). It is noted in the study performed by Zhou that membrane permeability of

metformin is a time-dependent and slow process. In other words, a person who is battling diabetes will not see immediate changes in their blood glucose levels. This can be problematic because if a blood sugar is high enough, there needs to be almost immediate regulation to ensure there are no long-lasting effects. A study on the mechanism by which metformin works found that, after three months, the amount of glucagon in the participants' bodies decreased by 4 ng/l. While it does appear that the metformin is successful in lowering blood glucose levels, the lactate, or lactic acid, levels increased from 0.93 mmol/l to 1.13 mmol/l (Hundal 2000). This increase in the lactic acid, if not controlled over time, could cause a type two diabetic to go into a state of lactic acidosis. According to WebMD, "very high levels of lactic acid cause a serious, sometimes life-threatening condition called lactic acidosis. Lactic acidosis can also occur in a person who takes metformin (Glucophage) to control diabetes" (WebMD). Metformin has many benefits in its regulation in blood sugar. While immediate consequences for this drug may not be seen right away, blood tests do show that, over time, this drug makes the blood slightly more acidic.

A second drug that is said to be effective is called Miglitol, or commonly known as Glyset, which is used to treat type two diabetes. Miglitol is an oral alpha-glucosidase inhibitor. This signifies that it prevents, or slows, the absorption of carbohydrates (i.e. sugars) into the body. According to WebMD, some common side effects of this medication are diarrhea, gas, and abdominal pain. It is also recommended not to use table sugar or to drink non-diet soda to relieve symptoms of hypoglycemia because this drug delays the breakdown of table sugar (WebMD). An evaluation conducted by Lesley J. Scott and Caroline M. Spencer notes that "Miglitol generally had no effect on fasting serum insulin levels. There was also a trend to a decrease in bodyweight with Miglitol treatment during the trial period" (Scott 2000). The study that was conducted used participants that were deemed healthy during the screening process. They did see some positive

results, but it is unsure how well the drug will function in individuals that have underlying diseases or conditions. In the concluding statements of the evaluation, it is noted that "Miglitol is not indicated for use in patients with diabetic ketoacidosis and is contraindicated in patients with inflammatory bowel disease, colonic ulceration or partial intestinal obstruction, in patients predisposed to intestinal obstruction, in individuals under the age of 18 years and in pregnant or lactating women. Miglitol monotherapy does not induce hypoglycemia, but may potentiate the hypoglycemic effects of other antidiabetic drugs" (2000). Miglitol is not as commonly used as other type two diabetic medications. While it is an option, the risks seem to outweigh the benefits.

A second medication that falls in to the alpha-glucosidase inhibitors is a drug called Acarbose, or commonly known as Precose. This oral medication is used to treat type two diabetes. Like the other drugs mentioned, common side effects are diarrhea, gas, constipation, and abdominal pain. Acarbose can be given to patients that are in the pre-diabetic stage, as it "is effective in delaying or preventing the progression of prediabetes to type two diabetes mellitus" (Hu et. al 2015). It was concluded by the authors of this study that "Acarbose displays ethnicity-specific effects. It is likely that the superior results in Eastern populations are related to the mechanism of action of Acarbose, which inhibits glucosidase and thus delays the formation of glucose, slowing its absorption and finally decreasing blood glucose" (2015). The reason for Eastern populations having a better outcome with Acarbose than in Western populations is most likely due to the food that these populations eat. Western populations eat more processed foods, while Eastern populations eat less processed foods. This is a proposed reason for the overall effect of this drug.

Pioglitazone, commonly known as Actos, is another medication used to treat type two diabetes. For someone that is taking this oral medication, they might have side effects like sore

throat, myalgia, weight gain, or tooth problems (WebMD). As of late, there have been ethical concerns regarding this drug. A meta-analysis of randomized trials with this drug, performed by four different researchers, prompted the question on the influence of medications of this class on cardiovascular outcomes. A total of 19 trials enrolling 16,390 patients were analyzed. It was gathered that 375 of 8,554 patients (4.4%) receiving this drug resulted in death, myocardial infarction, or stroke. It was also gathered that "serious heart failure was reported in 200 (2.3%) of the pioglitazone-treated patients and 139 (1.8%) of the control patients." It is noted that cardiovascular disease remains the most frequent cause of death and morbidity among patients with diabetes mellitus. It was concluded overall that "the incidence of serious heart failure was increased by pioglitazone, although without an associated increase in mortality" (Lincoff et. al 2007). In the same class of drug, Avandia, commonly known as Rosiglitazone, presents itself. Avandia is a drug that is used to treat type two diabetes by increasing insulin sensitivity. It does so by decreasing the amount of glucose released by the liver. It does not cause the body to make more insulin, therefore, when used alone, Avandia does not cause low blood glucose (Joslin Diabetes Center). Some common side effects of taking this oral medication are a headache and a cough (WebMD). A meta-analysis of the use of this drug has some startling data. It was noted that "myocardial infarctions occurred 14% more often with rosiglitazone compared with metformin…, and 178% more often than with insulin" (Bloomgarden 2007). Bloomgarden concluded that rosiglitazone is "associated with a significant increase in risk of myocardial infarction and of death." These two drugs have raised much concern over the last few years, especially Avandia. Both of these drugs have been called into question and have been questioned on whether or not they should be prescribed at all. It has made researchers rethink the idea of treating type two diabetes with medications other than insulin.

Insulin, like mentioned above, is a naturally producing hormone in the body. There is concern ethically about using insulin as the treatment option for type two diabetes. There is concern because some people believe that it is unethical to receive insulin that was mass produced from human genes. The rationale behind this concern is because of the fact that the insulin that is being produced from human genes came from embryonic stem cells. This belief that receiving insulin, however, should be a false statement. Insulin was designed to work perfectly in our bodies. There are insulin receptors all over our bodies to stimulate glucose uptake into cells. Insulin and glucose are a pair that work well together. When an influx of glucose enters the body, insulin secretion increases. When there is a small amount of glucose in the body, the amount of insulin decreases. This, of course, is what happens in non-diabetic people. By treating hyperglycemia with its partner, insulin, many concerns of other diabetes management drugs are alleviated. It is stated in the *El Paso Times* that "insulin can help lower the chances of blood vessel problems, as well as heart attack and stroke, by offering better glucose control" (Mier 2009). The author of this article, a clinical instructor, states that "insulin therapy is often the best option for effective treatment of diabetes." This shows how people that have a medical background agree that insulin is the best option for diabetes management.

Economics of Diabetes Treatment:

Paying for any medical concern can be a financial burden for many people. It can be even worse depending on the type of insurance you have or if you have insurance at all. For diabetics, the cost of insulin is becoming so expensive that people cannot afford to regulate their blood sugars. A reason for this is because of the fact that there is not a generic form of insulin. According to a NPR talk regarding insulin, when insulin was first mass produced, it was taken and purified from pigs and cows. As technology advanced, researchers found ways to produce human insulin

by placing the gene that codes for insulin in bacteria. However, instead of keeping both forms of insulin on the market, the older method became obsolete in the United States. It eventually was taken off the market (NPR 2015). During this NPR talk, it was said that "the drug now costs up to $400 a month. And because of that high cost, many of the estimated 29 million Americans with diabetes can't afford it." This is concerning because many more complications will be seen with the people that are diabetic, all because they cannot afford the drug that keeps their body from completely turning on them. For the Eli Lilly Company, "insulin was an important product for [them], one of the world's largest pharmaceutical manufacturers with sales of over $5 billion" (Christensen 2004). It was suggested from this report that people that live with diabetes spend "$10,000 per year." This accounts for insulin, syringes, blood glucose testing equipment, complications, and doctors' visits. According to Exhibit 4 from the report by Christensen, in 1994, the Eli Lilly Company profited $456 million dollars in North America alone. The next closest competitor was the Novo-Nordisk company, profiting $132 million. This shows how insulin can be so expensive in the United States. There is one dominant company that controls the prices of insulin. The Eli Lilly Company is using the method of the human insulin gene being placed in bacteria to mass produce. They are no longer utilizing the cow and pig method. This is problematic because the amount of people with diabetes is increasing and the cost for everyday life is increasing as well. With this being said, it is becoming increasingly harder for people to pay for treatment for their diabetes.

A Day in the Life of a Diabetic:

Providing the facts and treatment options that are currently available for diabetes helps show the severity of the disease. But this does not show how the people and their family members are affected by the disease. For me personally, I have a cousin that was diagnosed with type one

diabetes at a very young age. At the time, she was too young to understand what exactly was going on. After almost thirteen years of living with diabetes, she has come to understand what diabetes actually is. To help capture the day in the life of a diabetic, I interviewed my aunt. My aunt notes that my cousin was hospitalized for three days after being diagnosed with diabetes. After those three days, they were expected to take my cousin home and treat this disease. For many people, when a loved one is diagnosed with diabetes, especially type one, it is usually the first occurrence of it in the family. According to my aunt, "There is never a moment or a break where I don't have to think about diabetes." She goes on to say, "Diabetes is the last thing I think about before going to bed and the first thing I think about when I wake up." For my cousin, the start of treating her diabetes for the day starts at 7:30 in the morning. From that point on, her blood glucose is checked every 2 ½- 3 hours. As my cousin grew up, she began going to school. For a diabetic, your daily school routine is much different from those that are not diabetic. During the middle of the day, my cousin has to leave class for a snack, check her blood sugar in the nurse's office before lunch, gym, and before leaving school to come home. If she happens to have an episode of hypoglycemia or hyperglycemia, she may be unable to concentrate or participate in school activities. Once home, her blood sugar is checked before dinner, before her snack at 8:00 PM, and right before she goes to bed. My cousin has been fortunate enough to have very caring parents and siblings that help her manage her diabetes. However, my cousin is at the start of her teenage years, and, with that, comes a lot of hormonal changes. Natural hormonal changes in the body can cause drastic changes in blood sugar levels, even for non-diabetic people. So, for diabetics, diabetes management is even more crucial during the teenage years. My cousin has a diabetic pump, which allows insulin to be given without injections multiple times a day. While this pump has alleviated a lot of pain and stress, it can still be problematic. It is very easy for the tube connecting the pump to the body to

clog, thus causing hyperglycemia. And while the pump lessens the amount of daily injections, the pump needs to be changed out every 2-3 days. My aunt concluded that she would take the diabetes away from my cousin if she could. Diabetes care and management is a strategy game, and without a support system around you, diabetes is a very difficult disease to treat for (L. Palese, personal communication with author, January 29, 2017).

Future Innovations:

Diabetes regulation via medication is not the favored method. Physicians would prefer that type two diabetics change their lifestyles and eventually wean off the prescribed medications. However, type one diabetics do not have this luxury. Because physicians know that the acquisition of type one diabetes is genetically based, other treatment options have been developed. According to Rebecca Boyle, writer for *Popular Science*, "researchers at the Mayo Clinic are developing an artificial pancreas that accounts for slight, low-intensity physical activities that can impact blood sugar levels. The researchers are developing a closed-loop system that includes a glucose monitor, automatic insulin pump, activity monitors that attach to the body and a central computer that uses an insulin-delivery algorithm to determine how much of the hormone to dispense" (Boyle 2011). A study conducted on the concept of an artificial pancreas was tested on one-hundred virtual patients. It was concluded that the Model Predictive Control (MPC) is one of the most commonly used methods for the AP [artificial pancreas]. The main advantage of MPC is the ability to handle hard constraints on input variables and soft constraints on output variables in systematic ways. This method reduces the time spent in hypoglycemic states and also hyperglycemic states (Boiroux et. al 2017). Many different methods are being explored as to the best method for the artificial pancreas. As it stands right now, it is a combination of advances that have been made in the diabetic

field. There is more research and trials to be performed, but each day is one step closer to perfecting this new discovery.

Stem cell research has, as of late, been a controversial and ethical conversation in the United States media. This type of research is controversial because of the need to take non-differentiated embryonic stem cells to make the beta cells that produce insulin. An article written in *National Geographic* states that father, and now stem cell researcher at Harvard, Doug Melton, "has created virtually an unlimited supply of the cells that are missing in people with type one diabetes" (Weintraub 2014). The technique developed by Melton also works using stem cells that don't require destroying an embryo. This voids the controversial and ethical concerns. He notes that induced pluripotent stem cells are a possible option. A study published in the *Journal of Pharmacological Sciences* concludes that "we [the researchers] have managed to produce insulin secreting PE [pancreatic endoderm] from hESCs. These hESC-derived PE were then transplanted into pregnant female diabetic mice, where they significantly alleviated diabetes mellitus symptoms including hyperglycemia and hyperinsulimenia (Xing et. al 2016). This study shows the promise that stem cell research has in the diabetic field. While there are ethical concerns about taking embryonic stem cells, it is possible to take stem cells from adults and induce the pluripotent cells to create the necessary beta cells that are deficient in all diabetics to produce the insulin necessary to regulate blood sugars. With more research, it is obvious that great strides in the diabetic community will be made.

Prevention is Possible with Diabetic Resources:

Living with untreated diabetes is difficult. Type two diabetes, however, can be avoided. Someone with type two diabetes can decide at any moment that they want to change their lifestyle so that they may cure themselves from diabetes. Going about this alone can be difficult. However,

there are plenty of resources that are available for type two diabetics to start living healthier lives. A few very credible sources to find ways to live healthier with diabetes is through the American Association of Diabetes Educators. On their website, they offer programs, lifestyle tips, and ways to get in touch with a diabetes educator. Another credible source for people wanting to begin the fight against diabetes is through the National Institute of Diabetes and Digestive and Kidney Diseases. On their website, they offer ways to live with diabetes so that it is controlled. For some people, the first step to ridding themselves of the disease is to get it under control. The Centers for Disease Control and Prevention offer resources on the most current diabetes treatment options, the basics about diabetes, and also programs and initiatives. The American Diabetes Association offers resources about the basics behind diabetes, living with diabetes information, and information on food and fitness. On all of these websites, ways to eat healthier, some with recipes, are available. Additionally, the National Football League has accepted the challenge to fighting childhood obesity. Type two diabetes has changed in recent years from the initial beliefs of type two diabetes being adult onset. Now, type two diabetes is being seen and diagnosed at any age. The NFL Play 60 program encourages children to exercise for at least an hour a day, whether it be walking, playing sports, or even dancing. Childhood obesity is one of the greatest causes of type two diabetes in today's society. The amount of children in the United States that are considered obese is frightening. These organizations realize how important it is to treat diabetes. Diabetic researchers and educators can only do so much when it comes to diabetes. The individual that is struggling with type two diabetes needs to make lifestyle choices that will better themselves so that they can rid themselves of type two diabetes.

Conclusion:

Diabetes has been around since at least 1425. Its extensive history shows how prevalent diabetes is and how it is something that people need to take more seriously. Diabetes, as a whole, is amongst the top five causes of death worldwide. People's lives can be drastically changed or ended if their diabetes goes undiagnosed or untreated. Type two diabetes is by far the most common type of diabetes and is a disease that can be completely avoided. With changes in lifestyle, dietary habits, and exercise patterns, people with type two diabetes can fight this disease. With diabetes being an epidemic throughout the world, many treatment methods have been developed. Though type two medications have been helpful, the most helpful treatment option is insulin. The naturally occurring hormone in our bodies is the best soldier in the fight against diabetes. Human physiological mechanisms respond effectively and efficiently to insulin, a natural product of the body. There have been many improvements for alternative treatments. For type one and possibly type two diabetics, the concept of having a computerized "pancreas" can alleviate much of the concerns and worries. Stem cell research can take our pluripotent cells and create beta cells that produce insulin. The great strides that have been taken in the fight against diabetes have helped tremendously, but the world will not be able to rid itself of diabetes unless the entire population wholeheartedly believes they can and begins to also hold up their part in eradicating this disease?

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