Importance and effectiveness of technologies in Type 1 diabetes mellitus and Type 2 diabetes mellitus treatment

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Abstract
As of 2019, in the United States, approximately 35.5 million people had type 2 diabetes mellitus and 1.9 million people had type 1 diabetes mellitus. With every following year those numbers continue to grow. Affecting individuals face a significant decline in life quality and are required to manage blood glucose levels to minimize associated complications. Glycated hemoglobin (HbA1C) test quantifies the amount of glucose attached to the hemoglobin and serves as the main indicator of diabetic control. Depending on the diabetes type, traditional treatments such as oral medications or subcutaneous insulin injections are available. The recent developments in technologies, however, provide innovative equipment that revolutionizes the treatment of diabetes and improves health outcomes for affected individuals. This research focuses on describing newly available devices and their effectiveness in treating diabetes. Such devices include insulin pumps, continuous glucose monitoring systems, and associated software. These devices working independently from each other (or in combination) are pre-programmed to continuously inject insulin and monitor blood glucose.

Background (cont.)
Type 1 Diabetes Mellitus (T1DM) is an autoimmune disease in which β cells are destroyed by autoreactive immune cells, halting the secretion of insulin. Without insulin, the body is unable to maintain glucose homeostasis which in turn leads to high blood sugar (hyperglycemia). Most people are diagnosed with T1DM in early childhood. The symptoms often accompany frequent urination, blurred vision, fatigue and weakness, extreme hunger, weight loss, and increased thirst. To manage the disease, insulin therapy is required, which involves subcutaneous injections of synthetically produced insulin.

Type 2 Diabetes Mellitus (T2DM) is a metabolic disorder caused by development of resistance to cells in insulin and failure of β cells to produce enough insulin. Both of those factors lead to the imbalance in insulin and glucose levels. Although exact causes for T2DM are unknown, obesity and genetic predisposition are two of the contributing factors. Most of the symptoms are similar to T1DM, but T2DM is not an autoimmune disease and therefore not manifested by the presence of autoreactive immune cells. In addition, most Type 2 Diabetes Mellitus patients are diagnosed in middle to late adulthood. Treatments can include insulin therapy, diet, exercise, and medications. For both conditions, prolonged hyperglycemia is associated with complications such as neuropathy, nephropathy, retinopathy, cardiomyopathy, and ketoacidosis.

Recent technological developments in medicine brought new therapeutic devices to treat T1DM and T2DM. Continuous glucose monitoring (CGM) device is one of those technologies. This system includes a sensor that is attached to the patient’s skin, with a small cord inserted subcutaneously. The sensor measures blood glucose and wirelessly sends readings to the smart device. The data is sent at certain short intervals, allowing patient to make real-time informed decisions.

Obtained glucose trends help patients to balance diet, physical activity, and decrease the need for classical fingerstick testing.

Another vital technology is an insulin pump. This small machine is attached to the patient’s skin with a small plastic tube inserted subcutaneously. Throughout the tube, a device both automatically and manually delivers doses of insulin. In addition to pre-programmed doses of insulin that are delivered 24/7, patients can initiate manual delivery during meals. Some modern pumps are wireless with insulin containers located inside pods, while other pumps require an externally connected device.

Results (cont.)

In the clinical trial sponsored by Abbott (Freestyle Libre), the HbA1C measurements were evaluated at baseline and at week 8 of the study for CGM and control groups. Results indicate a decrease in HbA1C from 7.9%±0.9% to 7.5%±0.4% and no changes in the control group.

A decrease in glycated hemoglobin (HbA1C) indicates improved management of diabetes and decreased risk of complications associated with prolonged high glucose levels. From the clinical trials which evaluated the effectiveness of those technologies, it is clear there is an advantage over traditional treatment methods. In addition to improved diabetic control, those devices offer more comfortable ways for patients to deal with their chronic conditions.

Background
Insulin is a hormone secreted by β cells in the pancreas. This peptide hormone regulates the metabolism of macronutrients such as carbohydrates, fat, and protein. Most importantly, insulin promotes the absorption of glucose via translocation of GLUT4 transporter in adipose and muscle tissues.

Objective
The study investigates the effectiveness of continuous glucose monitoring systems and insulin pumps as therapeutic devices in managing Type 1 Diabetes Mellitus and Type 2 Diabetes Mellitus.

Results
The study focuses on the two most popular CGMs: Dexcom and Freestyle Libre, and the two most popular insulin pumps: Omnipod and T:Slim. The data was collected from clinical trials sponsored by manufacturing companies. In a clinical trial sponsored by Dexcom the study evaluated the effectiveness of continuous glucose monitoring vs. standard blood glucose monitoring (fingerstick test, control group) in Type 1 Diabetes Mellitus patients. The measurements for Glycated hemoglobin (HbA1C) were collected at baseline and at 26 weeks of the trial. Results indicate a decrease of HbA1C from 8.9%±0.4% to 7.6%±0.9% in the CGM group and no change in the control group.

Conclusion
A decrease in glycated hemoglobin (HbA1C) indicates improved management of diabetes and decreased risk of complications associated with prolonged high glucose levels. From the clinical trials which evaluated the effectiveness of those technologies, it is clear there is an advantage over traditional treatment methods. In addition to improved diabetic control, those devices offer more comfortable ways for patients to deal with their chronic conditions.

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