ISSN:0976-0172
Journal of Bioscience And Technology
https://jbstonline.in/

The Benefits of Digital Technologies in Diabetes Management: An Analysis

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Article Info

Received: 30-06-2024 *Revised: 19-08-2024* *Accepted: 29-08-2024*

Abstract

Successful developments in technical innovations may promote greater contact between patients and medical professionals, mobile healthcare. High levels of health literacy and numeracy, self-management, and frequent meetings with clinicians are important for controlling diabetes mellitus, a condition that may be tough to control. Mobile health apps have improved diabetes treatment and prevention, despite not being substantially utilized yet. Patients may develop new routines and behaviors associated to treating their diabetes via the use of technology-based education. In order to present the roadmap for the digitalization of diabetes treatment in the Indian setting, this article provides an overview of the digital in use and recommends major technical adaption and governmental involvement.

Keywords: Diabetes milletus, Digital Health, Digital Technology, Insulin pens, Self-management, Treatment.

Introduction

Diabetes support with technological means While the idea of self-management is not new, there are new technologies that are coming out and devices that are becoming more accessible as patients become used to them. 1. The term "digital health" describes the practice of monitoring a person's vitals using wearable devices and then analyzing that data using mobile apps and the cloud. Thanks to advancements in communication and medical technology, doctors are able to get a deeper understanding of the individual physiology and behavior of their patients. Patients with diabetes and other long-term health issues now have more and more options for wireless data transmission, sharing, and gathering thanks to Internet-connected devices with sensors, transmitters, and software. 4. A second paradigm is emerging that makes use of communication technology to enable the remote provision of health services in real time. 5.

Building Bridges in Digital Health

Advanced wellness–based diabetes education programs developed by experts are proliferating, and some have even shown evidence of their efficacy in the form of research-based validation of their viability6. Are being made available to help people with diabetes better manage their illness and advance in their clinical engagement. 7. Encourage improved communication among patients, experts, and therapeutic staff8; these advancements make self-care management and accurate restorative status possible.

Why Digital Health Is Beneficial

Healthcare objectives may be met via the use of digital health technologies, especially advanced analytics. Consequently, it will benefit the whole healthcare industry, from patients to staff.
These populations have been historically neglected.
• Health care providers and patients will incur lower expenditures.

ISSN:0976-0172
Journal of Bioscience And Technology
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• Achieved significant progress in comprehending outcomes by developing tailored treatment programs. The operating efficiency of healthcare institutions, including hospitals, was improved.
• Improved diagnosis by using machine learning techniques 9.

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MATERIALS AND METHODS

Devices
Insulin pump
Among the most significant technological advancements in diabetes care throughout the last half-century has been continuous subcutaneous insulin pump therapy10. It is possible to avoid cardiovascular disease, retinopathy, neuropathy, and nephropathy. Switching to an insulin pump has been shown to be a very positive experience for patients in several studies11. Advancements in Pump Technology Throughout History: Arnold Kadish pioneered the use of continuous insulin administration in the US in the early 1960s. Insulin automatically raises blood glucose levels12. The artificial pancreas is made up of large pumps that are connected to automatic analyzers that monitor blood sugar levels. When the blood sugar levels start to fluctuate, the pump activity is controlled by servo mechanisms. Concerning Kadish's invention, the Bio-Stator posed problems due to its complex construction, difficult dimensions, and extended use. The first Mill Hill infuser was a battery-operated, thin-syringe pump with a detection range of up to 159 grams14. The insulin pump included a dual-rate mechanism that allowed the user to switch between a basal and an eight-fold greater prandial rate with the push of a button on the side. After their introduction in the late 1970s, pumps quickly became well-known among doctors. Notable pharmaceutical companies started putting money in about the 1980s. One of the first commercial insulin pumps was the auto syringe, which went by the name "Big Blue Brick" when it was debuted in 1978.

A pump for insulin: A skin patch with a subcutaneous injection site, tubing connecting the skin patch to the pump, and a slim, portable or wearable device with the pump and controls make up an insulin pump, a wearable medical device that constantly administers fast-acting insulin beneath the skin. The second kind, called a "tubeless system," is very simple and requires only two parts: a portable control device that may be remotely linked and a skin patch that contains the insulin and pump subcutaneously. 18. Insulin pumps are used by: Insulin pumps are available to all diabetes patients who need synthetic insulin. This include individuals with Type 1 and Type 2 diabetes, whether they are children or adults. This may also be used by patients with type 3c diabetes. For those who are expecting a child, suffer gastroparesis, or have experienced dawn phenomena
Excluded from insulin pump use are: Hand, finger, and wrist problems Low eyesight and blindness, Problems in maintaining pump attachment 19. Modern insulin pumps Insulin pen20 has shown dosage consistency, whilst syringes have not. Although insulin type, effectiveness, and safety are the most important considerations, other parts of insulin administration could influence results21. New insulin formulations and insulin pens are developed simultaneously. Using smart insulin pens (SIPs) in clinical practice has the potential to enhance diabetes patients' time22 by lowering glyceamic fluctuation.
Features of an intelligent insulin pen: Meal size, carbohydrate consumption, present blood glucose levels, and settings suggested by a doctor should be used to determine doses. Work with most popular diabetic monitoring apps, smartwatches, and smartphones23.
Consistently records the time, date, and dose of each injection—that is what makes an insulin pen SMART. Facilitates the use of a bolus calculator for more accurate dose calculations, relieving mental strain in the process. Keeps dosages from being skipped24.

Parts of an insulin pen include

The insulin is stored in this see-through plastic container, which is part of the pen. Pen Cap: The pen cap prevents harm to the insulin reservoir while the pen is not in use, which is necessary since other pens run out of insulin.
You can connect a single-use injectable needle to the insulin pen's rubber seal. These needles are designed for one injection only, and then you may throw them away. Take the

ISSN:0976-0172
Journal of Bioscience And Technology
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needle out of its packaging and put it on the pen before injecting the patient. Talk to your doctor about which pen needle is best for you.27. Dosage knob: Turn this knob to choose the insulin dosage you need. You can see the number of insulin units you've selected by rotating the knob in the dosage window.
After injecting insulin using the pen needle, push the injection button to provide the dosage.
The label on the insulin pen will tell you when the insulin is due to expire, in addition to the brand and kind of insulin.

Types on Insulin pens

If they're disposable or reusable: Some pens are disposable which means you can dispose of the entire pen after the insulin reservoir runs out or the insulin expires. Other pens are reusable. Simply change the insulin reservoir for one (a cartridge) and use the pen again[29].

The type of insulin you use: Manufactured insulins function differently depending on how long it takes for them to start functioning and remain in your body.

If they have digital components or not: Some insulin pens have an innovative app, which helps you last injected insulin and how much These may be "smart" or "connected" insulin pens. Other pens are "manual" which means there is no digital app[30].

How to utilize an insulin pen

Each time you use your pen:

• If you have more than one insulin pen, make sure to confirm the type and expiration date
• Verify that your insulin is clear and colorless and
that it is not clumped.
• When handling an insulin mix pen, roll it between
your palms and tilt it slightly.
• Eliminate the pen cap and wipe the top with
sterile alcohol.
• Fasten the pen's needle. For each use, use a fresh
needle.
• Assemble the right dosage and prime the pen first.
Double-check the dosage before administering.
• Take off the cap and inject into a spotlessly clean area. Unless your doctor tells you otherwise, hold the needle at a 90-degree angle.
• To guarantee that all of the insulin is absorbed, press the button to inject the medication and wait five to ten seconds.
• Take out and properly dispose of the needle.
• Insulin pens make it possible to swiftly and simply correct errors made when measuring out too much of a dose. While some pens allow you to reset your pen to zero units and start over, others eject extra insulin via the needle so that it does not enter your skin.

Dosage with an Insulin pen

Using the pen: After inserting the cartridge, just screw on the needle, prime the cartridge to remove any air, adjust the dose to your liking, inject the needle, and push the button to release the insulin. If you're using a pen that has an insulin suspension in it, such NPH or premixed insulin, gently shake the pen to mix the insulin. Pens are multipurpose writing tools that youngsters may bring on school trips and use at home. It is important to replace the needles in the pen after each usage to prevent insulin from leaking out of the cartridge. A large variety of shapes, sizes, and lengths are available for pen needles. Insulin cannot leak out of the small pen needles because they are so thin and very short. As opposed to syringes, which don't need any positioning, pens do. Patients who inject themselves with syringes should continue to monitor their blood sugar levels often and carefully when they switch to using insulin injection pens. There are variations in the quantity of pens. Different people have different dosing methods; some start with 1/2 or 1 unit and go up to ½ unit, while others use increments of 1 or 2. Pens make injections easier, but they are otherwise identical to insulin. For example, if you inject Humalog and Lantus at the same time, you will get the same amount of injections. Pens provide more precision and consistency than syringes. In addition, by dialing a mechanical device instead of staring at the side of a syringe, insulin users with limited visual acuity may be assured of a precise dosage while using a pen. Guidelines for using an insulin pen: Whenever you pick up a pen: Verify the kind and expiry date of each insulin pen if you own more than one. Check that your insulin does not have any clumps and is colorless and clear. A little tilt and rolling motion between the palms of your hand will make holding an insulin mix pen much easier. Take off the cap and use sterile alcohol to clean the top of the pen. Before

ISSN:0976-0172
Journal of Bioscience And Technology
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giving, be sure you double-check the dose. To inject, remove the cap and make sure the region is completely clean. Keep the needle at a right angle to your body unless your physician instructs you otherwise. To ensure complete insulin absorption, administer the drug as directed and wait for it to take effect.

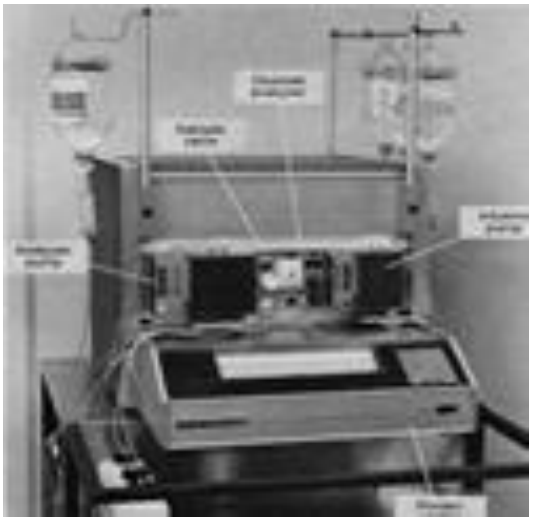

Fig. 1. Bio-stator: An insulin infusion device regulated
by glucose and powered by a computer
Adapted from:https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2710.2009.01048.x

five to ten seconds[33]. Insulin pens make it possible to swiftly and simply correct errors made when measuring out too much of a dose. While some pens allow you to reset your pen to zero units and start over, others eject extra insulin via the needle so that it does not enter your skin[34].

How significant are smart insulin pens as a tech development: Regarding the interoperability of connected devices, DrGriffin states: "Historically, an individual with diabetes had to manually record their insulin data often on paper or on a separate platform and could only view their glucose data in one place. Which also cuts recording time." Is also starting to notice the benefits of device connectivity in clinics. "We have someone's insulin and glucose data. On the same data, together, we can establish some tactics that will help the individual using the smart pen reach their customized goals," the speaker said. "The extensive

Fig. 2. The Mill Hill infuser.
Adapted from:https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2710.2009.01048.x

data has enabled me to conduct more meaningful consultations that benefit people living with type 1 diabetes and their families"[35].

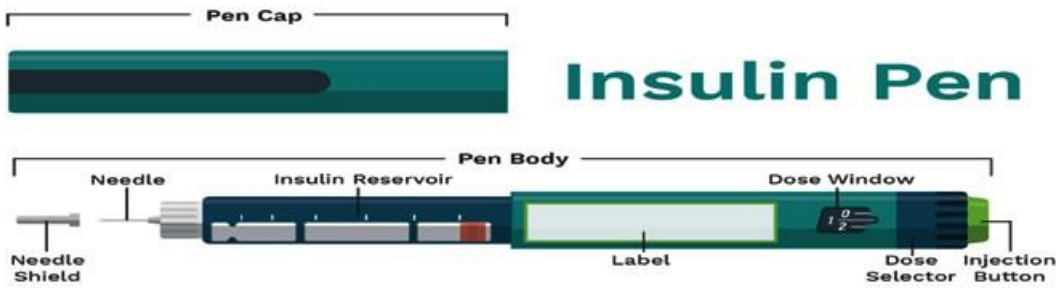

Fig. 3. Adapted from: https://images.app.goo.gl/jWyE455inqvdyYqPA

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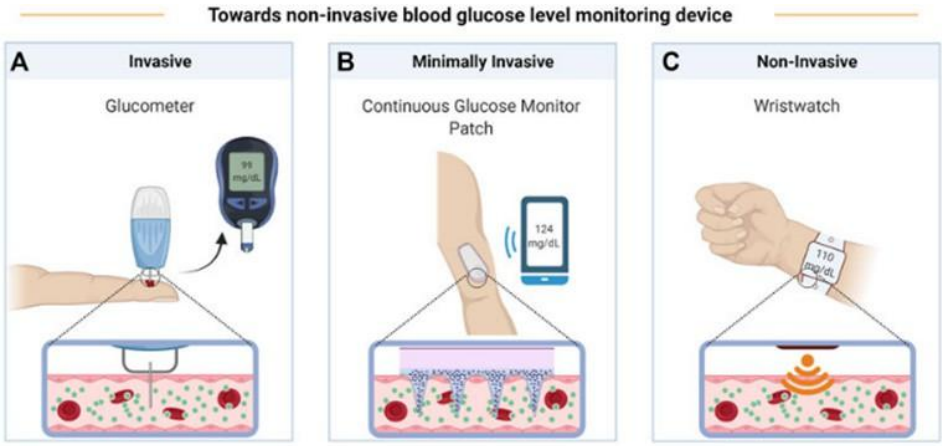

Fig. 4. Different blood monitors

Adapted from:
https://www.frontiersin.org/journals/chemistry/articles/10.3389/fchem.2022.994272/full

Blood glucose monitor

Diabetes mellitus and other conditions linked to fluctuations in blood glucose levels may be better understood with the use of blood glucose monitoring devices. While frequent blood glucose monitoring is helpful for diagnosing and treating certain people with type 2 diabetes mellitus, it may not be required for those whose disease is well managed with dietary changes or oral anti-diabetic drugs. However, it may be necessary to monitor blood glucose levels while titrating oral hypoglycaemic drugs, such as those for hypoglycemia.

Diagnostic testing

Test for Capillary Blood Glucose: In particular, two hours after eating and while fasting, blood may be collected from the earlobe, palm, forearm, or heel. Compared to finger-prick testing, data from other sites are just as reliable. If the patient would benefit more from using an other location, a deeper lancet may be necessary. Inquire with the manufacturer of the glucose meter as to whether or not it is feasible to conduct tests at many sites using the gadget. Sticky test strips and a skin-prick glucose meter. Get a reading of your blood sugar. These "smart" devices can communicate with linked smartphone apps because to the little volume of blood they need (0.3 to 1 mL) and their Bluetooth capabilities. Healthcare providers overseeing the management of a diabetic patient may find this data helpful38. A venous blood sample, also known as a plasma sample, is obtained by venipuncture and then processed in a commercially-grade laboratory that has completed the essential rigorous quality control inspections39. Capillary blood glucose testing is this method. However, this is subject to standards set by both academic institutions and businesses. Repetitive, risky, and unsuitable for regular specimen collection40 because to the possibility for regional tissue harm. As part of continuous glucose monitoring (CGM), a disposable, water-resistant sensor is placed on the back of the upper arm or abdomen to measure glucose levels in interstitial fluid or blood. Depending on the product, the sensor may remain on the patient for anywhere from three to fourteen days. By scanning the sensor with a reader, one may monitor the patterns in the interstitial fluid glucose level during the last eight hours. Continuous glucose monitors can save glucose data for up to ninety days. Caregivers and family members may view the CGM's data using a smartphone app; the device can send alarms or messages often, even during hypoglycemic spells. In addition, if the system detects or expects a decrease in BSL, certain CGMs may be utilized in combination with insulin administration to stop insulin supply. Calibration tests involving finger pricks are required twice day for certain older CGM devices. Contrarily, no calibration is required of gadgets.
Positive aspects: The cost-effectiveness of flash monitoring compared to CBG self-

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SMBG is necessary for individuals with type 1 or type 2 diabetes who are on intense insulin treatment or sulfonylureas. When checking for hypoglycemia while you sleep, taking your interstitial glucose levels as often as every five minutes during the hour is a huge help.
Downside: CGM-measured interstitial fluid contains glucose before blood. Monitoring rapidly changing blood glucose levels by looking at the interstitial fluid isn't always the best course of action. Customers from lower income brackets or living in places uncared for by insurance or the government may not be able to purchase the sensors and devices, which cost about $5,000 per year. 42, 43.

Reducing the Risk of Diabetes in Infants

Monitor your glucose levels on a regular basis: A glucose meter is an essential tool for this task. Ensure a normal cholesterol level: A higher risk of cardiovascular disease and stroke is associated with diabetes since the condition increases and decreases cholesterol levels. Make sure you eat properly and exercise often. What you eat matters when you're diabetic. Eat every two to three hours rather than waiting four to six hours in between. Not exercising when your blood sugar is too high or too low is just as important as exercise. One of the primary variables impacting obesity is losing weight. Obesity increases the risk of cardiovascular disease45 by raising blood cholesterol levels.

RESULTS AND DISCUSSIONS

In the above mentioned data we have mentioned about the different types of devices which are used to diagnose the diabetes. We have known about the normal techniques which are used to check the blood glucose levels. The digital methods are more useful than normal techniques due to the easy availability. The above mentioned devices are Insilin pump, Smart insulin pens and Blood glucose monitor.

Insulin pump has many advantages compared to traditional insulin are they improve glycemic control, more flexible lifestyle, fewer injections, better for younger children. Those who use long-term pump therapy maintain significantly better blood sugar management than MDI users. Many people who switch from MDI to an insulin pump note an improvement in their quality of life.
Fewer insulin injections.

Smart insulin pens found to be more potential due to their connectivity, real time evaluation and it is determined by evidence helps to improve quality of life.

Cnontinuous blood glucose monitors helps the patients to become more aware of their blood condition which affected by several factors. Also improves the cardiovascular risks and reduced cardiovascular events, overall it improves the quality life of the patients.

CONCLUSION

The monitoring and analysis of data related to diabetes makes use of several digital technologies. Finding the technology that will work in the long run is the hard part. It is important to make sure that these new technologies are inexpensive and accessible to all populations and health systems, even if they have a lot of promise.

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