WHITE PAPER

SIMPLIFYING DIABETES CARE USING DIGITAL HEALTH PLATFORMS

Abstract

Diabetes is a chronic disease impacting over 500 million people globally (1). Proper management of diabetes requires periodic monitoring of glucose levels and research into biomarkers along with the right diet and exercise. Patients can often feel burdened by the complexity of treatment, leading to sub-optimal clinical outcomes.

Here, we examine the role of technology in addressing the challenges of diabetes management. This includes evaluating next-generation digital health platforms that aggregate data from medical devices, wearables and other smart devices for analysis to generate relevant and real-time insights that inform timely treatment interventions.

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Introduction

Globally, diabetes mellitus (DM), characterized by high blood sugar levels, is one of the most common chronic diseases. In the US, the medical cost of diabetes is estimated to be US $237 billion annually (2) and is one of the fastest-growing economic burdens on the health care system (3).

When managed improperly, DM can lead to other complications such as retinopathy, diabetic foot, nephropathy, and cardiovascular diseases (CVDs). This is because chronic hyperglycemia can damage tissues and, in severe cases, may result in organ failure. Blindness, renal failure, and foot amputations are all long-term complications associated with chronic hyperglycemia (4).

The two most common types of diabetes are Type 1 and Type 2 DM. Type 1 DM is characterized by deficient insulin production and individuals are normally diagnosed during childhood or adolescence. Type 1 DM treatment relies on the daily administration of insulin delivered through multiple injections or an insulin pump (4, 5).

Type 2 DM, however, is caused by the body's cells becoming less responsive to insulin. This phenomenon, known as insulin resistance, is strongly associated with modifiable risk factors such as a sedentary lifestyle, an unbalanced diet, and obesity (6). Early-stage Type 2 DM is treated using oral medications to improve insulin absorption or secretion. However, insulin administration may also be required, particularly in late-stage Type 2 DM (4). A balanced diet, weight loss, and close monitoring can help manage Type 2 DM, preventing further progression and improving quality of life. With good lifestyle management, some individuals with Type 2 DM can maintain normal blood sugar levels without medication (7).

Digital Solutions to Manage Diabetes

One of the leading use-cases of digital health platforms is facilitating patients and health care providers to track diabetes care. The reason for this is that the effective management of DM requires patients to have a high degree of health literacy to track their daily carbohydrate intake, monitor their blood sugar levels, and maintain stringent nutrition and exercise regimens (8). This need to track key health indicators and adhere to complex treatment plans can be burdensome for many patients.

But consistent monitoring is the key to promoting positive outcomes. To this end, digital tools like remote monitoring devices and real-time analytics for quick insights allow patients to take back control of their treatment journeys. Digital health platforms can serve as a lifestyle management tool for patients with Type 2 DM. However, for patients with Type 1 DM, digital technologies can aggregate and analyze data from insulin pumps and continuous glucose monitors to generate condition-specific insights.

Here are some ways in which digital solutions help:

- **Monitoring blood glucose levels** – Traditionally, the self-management of blood sugar levels has involved using the fingerstick approach. However, such methods can be painful when multiple measurements are taken every day (8). Newer techniques, such as continuous (CGM) and flash glucose monitoring, where sensors are positioned subcutaneously, have been developed for Type 1 DM (9, 10). These medical devices enable real-time monitoring of blood sugar levels without the need for finger-pricking. Measurements from continuous blood glucose monitors can be transmitted to a patient's smartphone, smartwatch, or cloud (11). These devices improve glycemic control and reduce incidences of hypoglycemia more effectively compared to standard blood glucose monitoring among children and adults with Type 1 DM (12).
- **Intelligent insulin delivery** – Technology also plays a vital role in automated insulin delivery systems, which consist of a continuous blood glucose monitor and an insulin pump. An integrated algorithm uses blood glucose readings, predicted incidences of hyperglycemia, and information from previous insulin administrations to calculate the optimal dose of insulin to be delivered (11). Though automated insulin delivery systems(Closed loop) still rely on patients to input their scheduled mealtimes and planned carbohydrate intake, the system mimics the function of the pancreas to simplify the management of DM (11).
- **Staying ahead of adverse events** – Digital health platforms that leverage artificial intelligence (AI) and machine learning (ML) algorithms to analyze patient-generated data enable real-time monitoring of symptoms and the early detection of adverse events. These also serve as personal assistants for patients with DM (13). Variations in key health indicators can be communicated to clinicians, alerting them to concerning trends so they can effectively modify treatment plans (14).
- **Analyzing biomarkers through connected devices** – The widespread use of digital tools for managing diabetes has also led to the emerging field of e-epidemiology, where patient outcomes are monitored based on data generated from connected devices (13). This enables the identification of digital biomarkers associated with disease onset, elucidates the effect of other comorbidities on the severity of DM, and detects novel biological pathways that contribute to disease development.

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Digital Clinics and Hybrid Health Care

In the coming years, DM care will combine in-person and virtual care, with technology playing an increasingly important role. A huge amount of patient data is being generated from smart devices such as glucose monitors, insulin pumps, wearables, portable ECGs, and even socks with smart capabilities (13). This large quantity of data generated is advantageous to train ML algorithms to improve the accuracy of predictive analytics. While the digital clinic is not a replacement for in-person care, technology that facilitates the analysis of data generated from connected devices will enable more holistic patient care, where treatment is guided by multiple parameters.

Proper management of DM is imperative to prevent the onset of severe complications such as blindness, gangrene, and multiple organ failure that can accompany disease progression. Smart devices and wearables will become integral to maintaining glycemic control, offering several benefits that go beyond monitoring with the traditional fingerstick approach. Driven by AI and ML algorithms, predictive analytics based on data generated from smart devices will reduce hospitalization incidences induced by dangerous hyper or hypo-glycemia. Thus, a hybrid model of patient care, consisting of anywhere-anytime digital clinics coupled with in-person consultations, will likely be the future of DM management.

Conclusion

Managing a chronic disease like DM depends on the patient's adherence to medication, exercise, and nutrition regimens. Digital health platforms can prove useful for providers and patients as a way to supplement in-person care. Digital health platforms can aggregate data from insulin pumps, continuous glucose monitors, wearables and mobile apps, allowing patients to track their blood sugar levels and medication, activity, and dietary regimens on one dashboard. The use of AI and ML can provide crucial insights to avert adverse events, automate insulin delivery, and curate effective treatment plans. The way forward is to combine in-person care and expertise with strong next-generation capabilities and digital services to track patient progress and deliver enhanced patient outcomes.

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