Data Visualization in Diabetes Self-Management: Empowering Patients with Actionable Insights

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Abstract- Effective blood glucose monitoring and interpretation are crucial in diabetes management, helping patients maintain glycaemic control and mitigate risks of complications. This study explores the role of data visualization in empowering diabetic patients to manage their condition by transforming raw blood sugar data into actionable insights. The Diabetes Data Visualizer app was developed to assist patients in visualizing blood glucose trends and generating personalized recommendations. The app utilized simple line charts and bar charts to highlight blood sugar trends over time and compare morning vs. evening blood sugar levels, respectively. Key insights such as trends, peak levels, and fluctuations were derived, with recommendations provided based on average blood sugar levels and general trends. In a case study, the app analysed the blood glucose data of a diabetic patient over a 7-day period, and insights showed that the patient's blood sugar levels fluctuated within the normal range (70–140 mg/dL) and exhibited a general downward trend. While the app provided useful insights, several limitations were noted, including its thresholds, which may differ from standard clinical guidelines, and the need for additional features, such as generating recommendations from morning vs. evening comparisons. Future improvements aim to expand the app's capabilities by hosting it online and integrating more advanced analytics, including machine learning. These refinements could enhance the app's potential in helping patients and healthcare providers better manage diabetes.

Indexed Terms- Diabetes, Data visualisation, Self-management, Patient empowerment, Blood Sugar Monitoring, SMA (Simple Moving Average), Trend Analysis

I. INTRODUCTION

Diabetes is one of the most prevalent chronic diseases worldwide, affecting more than 422 million people according to the World Health Organization (World Health Organization, 2024). It is characterized by the body's inability to properly regulate blood sugar levels, either due to insufficient insulin production or an impaired ability to use insulin. Over time, uncontrolled diabetes can lead to severe health complications, including heart disease, stroke, kidney failure, and nerve damage (Christou et al., 2023).

The global burden of diabetes is growing, with both Type 1 and Type 2 diabetes becoming more common due to lifestyle factors, genetic predispositions, and aging populations (Zhao, Li, & Ma, 2024). Managing diabetes requires a multifaceted approach involving medication, diet, exercise, and continuous monitoring of key health metrics. Among these metrics, blood sugar levels play a critical role, as they provide real-time feedback on how well a person's diabetes is being controlled.

Monitoring blood sugar levels is crucial for preventing both short-term complications, such as hypoglycaemia (low blood sugar) and hyperglycaemia (high blood sugar), and long-term complications like cardiovascular disease and neuropathy. For individuals with diabetes, maintaining healthy blood sugar levels is critical in reducing the risks of cardiovascular disease, kidney failure, nerve damage, and other health issues that can result from prolonged hyperglycaemia (Christou et al., 2023). Central to effective diabetes management is the continuous monitoring of blood sugar levels, which provides patients and healthcare professionals with the data necessary to make informed decisions regarding treatment, lifestyle, and medication adjustments.

Why is Blood Sugar Monitoring Important?

Tracking blood sugar levels enables diabetic patients to understand how their bodies respond to different foods, activities, medications, and even stress. For instance, tracking allows patients to:

- Detect dangerous spikes or drops in blood sugar (hypoglycaemia and hyperglycaemia), which can lead to serious immediate complications if left unchecked.
- Tailor treatment plans: Monitoring helps doctors and patients adjust insulin doses, medication, or lifestyle factors (such as diet and exercise) to maintain blood sugar within a safe range (CDC, 2024).
- Prevent long-term complications: Consistently high blood sugar levels can result in serious health issues over time, such as nerve damage, cardiovascular disease, and kidney damage. Monitoring can help mitigate these risks by enabling timely intervention (Setyawati et al., 2024).

Monitoring is especially critical for older adults, who are at greater risk of complications due to the natural aging process and potential co-existing conditions such as heart disease or hypertension (Zhao, Li, & Ma, 2024). By keeping records of their blood sugar levels, patients and healthcare providers can detect trends, predict future health outcomes, and personalize treatment plans for better disease management.

In a more general context, normal fasting blood sugar levels typically range from 70 mg/dL to 125 mg/dL, while postprandial levels (after meals) can range up to 140 mg/dL. Levels exceeding 180 mg/dL are considered high and can indicate hyperglycaemia, whereas levels below 70 mg/dL suggest hypoglycaemia (Mouri & Badireddy, 2023). Monitoring these fluctuations is essential for managing diabetes effectively.

Table 1: Blood Sugar Levels, Classifications, and Descriptions (Adapted from Mouri & Badireddy, 2023)

This table outlines the standard classifications of blood sugar levels, including fasting, and postprandial, and abnormal ranges.

Blood Sugar Level (mg/dL)	Classification	Description
Below 70	Low (Hypoglycaemia)	Blood sugar is dangerously low, requiring attention
70 - 125	Normal (Fasting)	Ideal fasting blood sugar level
126 - 140	Normal (Postprandial)	Expected range after eating
141 - 180	Prediabetes	Considered higher than normal, requiring attention
Above 180	High (Hyperglycaemia)	Blood sugar is too high, possibly indicating a risk

This table presents the blood sugar level classifications used in the Diabetes Data Visualizer app. The thresholds are generalized to provide guidance on normal (which includes both fasting and postprandial), low, and high blood sugar levels as well as prediabetic stages based on averages and trends. The general thresholds used within the application may differ slightly from clinical standards such as those from WHO.

Current Methods of Blood Sugar Monitoring

Traditionally, blood sugar monitoring has relied on manual methods, such as finger-prick tests and paper logs, where patients record their readings throughout the day. While useful for immediate tracking, these methods are often limited in their ability to help patients see long- term trends or identify patterns that could improve self-management (Corabian & Chojecki, 2017). More advanced solutions, such as Continuous Glucose Monitoring (CGM) systems and diabetes management apps, have made it easier for patients to track their blood sugar levels in real-time and receive alerts when their glucose levels reach critical thresholds (Corabian & Chojecki, 2017). However, these solutions are often expensive, complex, and inaccessible to many patients, especially in low-resource settings.

In this context, data visualization emerges as a critical tool in helping individuals with diabetes better understand their health data. By transforming raw blood sugar readings into clear, interpretable visual trends, data visualization can empower patients to identify patterns, make informed adjustments, and engage more actively in their self-care. The ability to turn raw data into actionable insights enables patients to recognize how various factors—such as diet, exercise, and medication—affect their glucose levels, thus helping them make more effective decisions to maintain control of their condition (CDC, 2024b).

In this paper, we focus on the role of data visualization in diabetes self-management, emphasizing how visual tools can empower patients to better manage their health. We will examine the effectiveness of trend analysis, specifically using Simple Moving Averages (SMA), and demonstrate these techniques through the Diabetes Data Visualizer, a custom-built web application. The application enables users to upload blood sugar readings, visualize trends, and receive actionable recommendations based on their data.

II. LITERATURE REVIEW

Recent advancements in digital health tools have revolutionized the way diabetes is managed. Studies have shown that consistent blood glucose monitoring and effective data interpretation can significantly improve patient outcomes (Burford, Park, & Dawda, 2019). Continuous glucose monitors (CGMs) have made it easier for patients to collect real-time data on their glucose levels. According to the World Health Organisation, fasting blood sugar levels should typically remain between 70 mg/dL and 125 mg/dL, while postprandial levels up to 140 mg/dL are considered normal. Hyperglycaemia is diagnosed when levels exceed 200 mg/dL, and hypoglycaemia occurs when levels drop below 70 mg/dL (WHO, 2024). While patients now have access to more detailed data than ever before, interpreting these trends can be overwhelming without the right tools to analyse and visualize this information (Burford, Park, & Dawda, 2019).

Data visualization, when integrated into glucose monitoring systems, has proven to be an effective method for transforming complex data into understandable formats. Simple graphs, trends, and alerts have been shown to assist patients in making more informed decisions regarding their glucose control (Bults, Leersum, Olthuis, Bekhuis, & Ouden, 2023). Visual representations such as line graphs, bar charts, and moving averages help patients to easily track fluctuations and trends in their blood sugar levels.

Additionally, studies have found that patients who engage with data visualization tools are more likely to adhere to treatment recommendations and make necessary lifestyle adjustments (Burford, Park, & Dawda, 2019). These tools provide real-time feedback that not only empowers patients but also enhances communication between patients and healthcare professionals.

The Importance of Data Visualization in Healthcare
Data visualization has increasingly been recognized as a powerful tool in healthcare, particularly in chronic disease management. For patients living with chronic conditions like diabetes, the ability to monitor and interpret data is essential for making informed health decisions. Visualizing data, rather than presenting it as raw numbers, provides a way for patients to identify patterns, track progress, and make proactive adjustments to their treatment plans.

Research on Data Visualization in Healthcare has demonstrated several advantages (rishabh, 2024):

- Improved Comprehension: Studies show that patients are more likely to understand and act on their health data when it is presented visually. Line graphs, trend charts, and bar graphs make complex data more accessible.
- Increased Engagement: Visual feedback has been shown to improve patient engagement, leading to better adherence to prescribed treatments and a greater sense of empowerment in managing their health.

- Timely Intervention: By visualizing long-term trends, patients can spot deviations from their usual patterns early, allowing them to intervene before their condition worsens.

The Role of Data Visualization in Diabetes Self-Management

In the context of diabetes, managing blood sugar levels requires patients to track their glucose levels regularly, recognize trends, and adjust their behaviours accordingly. Data visualization enhances this process by allowing patients to see how their glucose levels fluctuate over time and identify triggers for spikes or drops in their blood sugar.

According to Burford, Park, and Dawda (2019), patients who used visual tools to track their blood glucose were better able to:

- Recognize how diet and exercise impacted their glucose levels.
- Identify patterns of hyperglycaemia (high blood sugar) or hypoglycaemia (low blood sugar).
- Adjust their medication or lifestyle to maintain glucose levels within a safe range.

Line graphs and trend charts help patients compare their blood sugar levels across different times of day (e.g., morning vs. evening) or identify recurring patterns after meals. These visual aids simplify the data interpretation process, making it easier for patients to understand their body's response to various factors.

Data Visualization and Risk Alleviation in Diabetes
Effective diabetes management not only improves day-to-day health but also reduces the risk of long-term complications such as cardiovascular disease, nerve damage, and kidney failure (Better Health Channel, 2021). Data visualization helps patients stay within their target glucose range by providing real-time insights and long-term trend analysis.

By making these patterns visible, patients are empowered to:

- Take preventative action: If a patient sees a consistent upward trend in their glucose levels, they can take steps to adjust their diet or medication before reaching dangerous levels.
- Improve communication with healthcare providers: Visual trends are easier to communicate and discuss during medical consultations, helping patients and providers make joint decisions about care (rishabh, 2024).

Research from Burford et al., (2019) shows that patients who regularly used data visualization tools were less likely to experience severe episodes of hyperglycaemia or hypoglycaemia. These patients were able to recognize patterns that helped them anticipate and prevent blood sugar extremes.

Empowering Patients Through Data Visualization

For many patients, data visualization is not just about monitoring their glucose levels but about feeling more in control of their health. Studies have shown that patients who use visual aids are more confident in managing their diabetes and more proactive in making changes to their daily routine (Wei et al., 2024).
Data visualization helps by:

- Making data actionable: Patients who can see their glucose trends visually are more likely to understand how their actions (e.g., meals, exercise) affect their health, making it easier to adjust their behaviours.
- Reducing cognitive load: Instead of overwhelming patients with numbers, visual tools help patients focus on the most critical trends, reducing the cognitive burden of managing a complex condition.

The importance of data visualization in chronic disease management, particularly in diabetes, is well-established. However, the challenge remains in developing tools that are accessible, easy to use, and capable of providing actionable insights for self-management. In this study, we demonstrate how data visualization can empower individuals to manage their diabetes more effectively through a custom-built web application, the Diabetes Data Visualizer. This tool allows users to upload their blood sugar data, visualize trends, and receive personalized recommendations.

The following sections outline the methods used in this study to collect, process, and analyse the data using the Diabetes Data Visualizer.

III. METHODOLOGY

This study evaluates the effectiveness of data visualization in diabetes self-management through a case study using the Diabetes Data Visualizer, a Flask web application that enables users to upload their blood sugar data, process it, and receive insights through trend visualizations and recommendations.

Data Collection

Blood sugar readings were collected from a diabetic patient over a specified period of 7 days. The data was recorded in a CSV file with three columns: Date, Blood sugar, and Time.

- The Date column contains the date of each reading in the format YYYY-MM-DD
- The Blood Sugar column contains the corresponding blood sugar level (in mg/dL).
- The time column indicates the time of day when each reading was recorded, allowing for comparisons between morning and evening readings.

The sample dataset used in this study is shown below:

Table 2: Sample Blood Sugar Data with Time and Time of Day Classification

This table presents sample blood sugar readings recorded over a period of 7 days. The data includes the date, blood sugar levels (mg/dL), time of day the readings were taken, and the classification into morning or evening for analysis in the bar chart visualizations.

Date	Blood Sugar (mg/dL)	Time	Time of Day
02/01/2024	120	10:00	Morning
03/01/2024	140	11:30	Morning
04/01/2024	180	09:45	Morning
05/01/2024	110	13:00	Evening
06/01/2024	150	15:30	Evening
07/01/2024	160	10:15	Morning
08/01/2024	110	16:00	Evening

This data was then uploaded into the Diabetes Data Visualiser app (excluding the time-of- day column) for processing and analysis. The inclusion of the time column allowed the app to generate insights comparing morning and evening blood sugar levels, in addition to general trends over time.

Data Processing and Visualisation

The Diabetes Data Visualizer app was utilized to analyse the collected blood sugar data. The analysis workflow is as follows:

1. Data Parsing: Upon uploading the CSV file, the Date column was parsed using Pandas' to_datetime() function, which allows for multiple date formats (e.g., MM/DD/YYYY, YYYY-MM-DD).
2. Data Cleaning: Any missing or invalid values in the Date and Blood Sugar columns were dropped to ensure data integrity.
3. Trend Analysis: A 5-day Simple Moving Average (SMA) was computed to smooth out the fluctuations in the blood sugar levels and highlight long-term trends.
4. Morning vs. Evening Comparison: The app split the data into two periods—morning (before 12:00 PM) and evening (after 12:00 PM). The average blood sugar levels for both periods were calculated to identify daily variations.
5. Data Visualization: Using Plotly.js, the app generated the following visualizations:
   - A line chart of blood sugar levels over time.
   - A trend line showing the 5-day SMA.
   - Average morning and evening blood sugar levels.
6. Insights and Recommendations: The app automatically generated personalized insights based on the average and peak blood sugar levels, as well as trends over time. The following criteria were applied to provide recommendations:
   - If the average blood sugar is above 180 mg/dL, the app suggests the user reduce carb intake and consult a healthcare professional.
   - If the average blood sugar is below 70 mg/dL, the app recommends monitoring meals and consulting a doctor if necessary.
   - If the average blood sugar is between 70 to 140 mg/dL, the app informs the user that the blood

sugar levels are within normal range and to continue maintaining diet and regular exercise.

- If the average blood sugar levels fall between 141 and 179 mg/dL, the app warns the user that these levels may indicate prediabetes and advises closer monitoring and consulting with a healthcare provider to discuss preventive measures.
- If the trend is increasing, the app advises the user to keep an eye on the upward trend and consult their doctor if the increase persists.
- If the trend is decreasing, the app warns against overcorrecting and recommends continued monitoring.

The thresholds used in the Diabetes Data Visualizer are based on general guidelines for blood sugar levels, allowing the app to provide basic insights and recommendations to users regarding their blood sugar trends. It is important to note that these thresholds, while suitable for this case study, may differ from more specific clinical standards that consider additional factors such as fasting or postprandial states.

The following diagram illustrates the full workflow from data collection to generating actionable insights and visualizations.

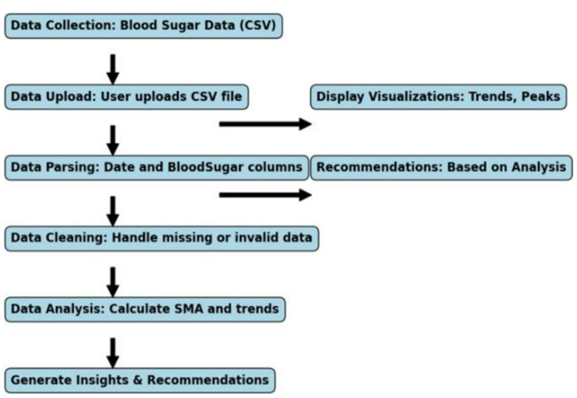

Figure 1: Workflow of Data Processing in the Diabetes Data Visualizer

This figure illustrates the complete workflow followed in the Diabetes Data Visualizer, from data collection through to the generation of visualizations, insights, and recommendations. Each step in the process is highlighted, showing how blood sugar data is parsed, cleaned, analysed, and transformed into actionable insights.

IV. RESULTS

Blood Sugar Trends

The blood sugar levels of the patient were plotted over a period of seven days, as shown in Figure 2 and Table 3. The trend indicates that the patient's blood sugar levels fluctuated between 120 mg/dL and 180 mg/dL, with an average blood sugar level of 138.57 mg/dL and a peak of 180 mg/dL. The 5-day Simple Moving Average (SMA), represented by the red dashed line in Figure 2, shows a general decreasing trend in the patient's blood sugar levels over time.

Table 3: Key Statistics from the Blood Sugar Data Analysis

This table summarizes the key statistics generated from the analysis of the patient's blood sugar levels. The average blood sugar level over the observation period was calculated as 138.57 mg/dL, while the peak blood sugar level reached 180 mg/dL.

Statistics	Value
Average blood sugar	138.57 mg/dL
Peak blood sugar	180 mg/dL

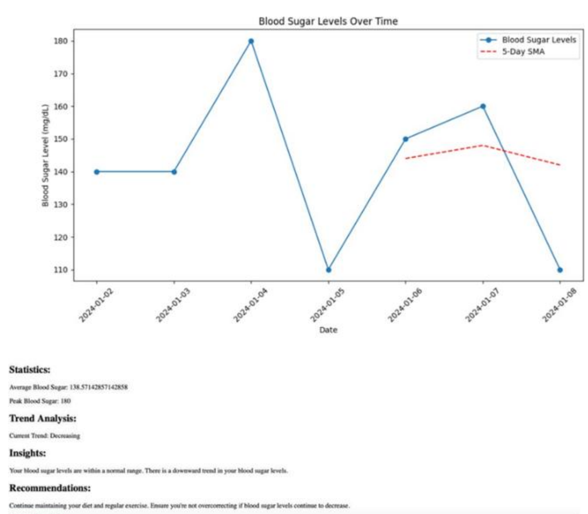

Figure 2: Blood Sugar Levels Over Time with 5-Day Simple Moving Average (SMA)

This figure shows the patient's blood sugar levels over a period of 7 days, with the trend smoothed by a 5-day

Simple Moving Average (SMA), represented by the dashed red line. The figure indicates fluctuations between 120 mg/dL and 180 mg/dL, with an overall downward trend over time. Insights derived from the data suggest that the patient's blood sugar levels are within the normal range, with recommendations to maintain their current regimen to avoid overcorrection.

Morning vs Evening Blood Sugar Levels

Additionally, the data was split into two time periods—morning (before 12:00 PM) and evening (after 12:00 PM)—to compare the average blood sugar levels for both periods. As shown in Figure 3 and Table 4, the patient's average blood sugar levels were higher during the morning (150 mg/dL) compared to the evening (123 mg/dL). This suggests that the patient may be experiencing blood sugar fluctuations influenced by the time of day, possibly due to dietary patterns, physical activity, or other factors.

Table 4: Average Blood Sugar Levels by Time of Day

This table displays the patient's average blood sugar levels measured during the morning and evening time periods. The morning average blood sugar level (150 mg/dL) was higher than the evening average (123 mg/dL), suggesting potential influences of dietary habits or daily activities on blood sugar fluctuations.

Time of Day	Average Blood Sugar (mg/dL)
Morning	150 mg/dL
Evening	123 mg/dL

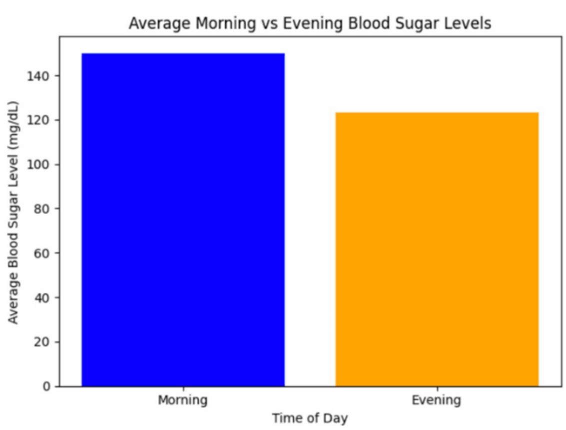

Figure 3: Average Morning vs Evening Blood Sugar Levels

This figure illustrates the comparison between the patient's average blood sugar levels in the morning (150 mg/dL) and evening (123 mg/dL). The higher morning levels suggest potential daily fluctuations that could be influenced by factors such as dietary patterns, physical activity, or the timing of medications.

Peak Blood Sugar Levels

The highest recorded blood sugar level during the observation period was 180 mg/dL, which occurred on 04-01-2024. This value was flagged by the system as a potential area of concern, with a recommendation to consult a healthcare professional.

Insights and Recommendations

Based on the blood sugar data analysis, the following insights were generated:

- Average Blood Sugar: The patient's average blood sugar level was 138.57 mg/dL, which is considered normal.
- High Blood Sugar Events: The app did not detect any events where blood sugar levels exceeded critical thresholds.
- Low Blood Sugar Events: The blood sugar levels are decreasing, and the app recommended monitoring to avoid further drops.

The case study results generated by the Diabetes Data Visualizer show a downward trend in blood sugar levels with no major concerning spikes. The Simple Moving Average (SMA) highlights a general decline in the patient's blood sugar levels, and the insights suggest that the current diet and exercise regimen should be maintained with caution to avoid overcorrection.

V. DISCUSSION

The findings from the blood sugar data analysis offer significant insights into the patient's blood glucose trends and provide valuable information for both self-management and clinical intervention. Data visualization, as demonstrated by the Diabetes Data Visualizer, plays a crucial role in simplifying complex data and presenting actionable insights that can empower patients in their self-management.

Blood Sugar Trends and General Patterns

The line chart (Figure 2) showcasing blood sugar trends over time reveals key insights into the fluctuations in blood glucose levels. The 5-day Simple Moving Average (SMA) smooths out the fluctuations, enabling the identification of long-term patterns. As observed in the results, the blood sugar levels fluctuated between 120 mg/dL and 180 mg/dL, with a general downward trend over the period of analysis. These results are consistent with research indicating that many individuals with diabetes experience fluctuations in blood glucose levels based on daily activities, dietary habits, and medication timing (Shin et al., 2020) (Mayo Clinic, 2019).

In this case study, the patient's average blood sugar level was 138.57 mg/dL, which we interpret as a postprandial reading. According to clinical guidelines, postprandial blood sugar levels within this range are considered normal (American Diabetes Association, 2024), which justifies the app's classification of this value as being within the acceptable range. This assumption plays a key role in the insights provided, such as advising the patient to continue their current regimen rather than overcorrecting, as no critical deviations from the norm were identified.

The Simple Moving Average (SMA) provides a more holistic view of the overall trends rather than focusing on isolated spikes or drops in blood sugar levels. Studies show that visualizing trends using moving averages helps patients and healthcare providers identify early warning signs of blood sugar mismanagement and adjust interventions accordingly (Smit, Schat, & Ceulemans, 2022). In this study, the downward trend may suggest that the patient's blood sugar control is improving over time, possibly due to better dietary or medication adherence.

Morning vs Evening Blood Sugar Levels

The comparison of average morning and evening blood sugar levels (Figure 3) shows that morning blood sugar levels were consistently higher than those in the evening (150 mg/dL vs 123 mg/dL, respectively). This finding aligns with research that suggests a significant proportion of individuals with diabetes experience dawn phenomenon, where blood glucose rises in the early hours of the morning due to the body releasing counter-regulatory hormones such as cortisol and glucagon (Seladi-Schulman, 2021). This phenomenon may explain the elevated blood sugar levels seen in the morning.

Alternatively, the higher morning blood sugar levels may also be attributed to dietary intake and activity levels. Studies have shown that meals, particularly those high in carbohydrates, can lead to increased blood glucose levels (O'Hearn et al., 2023). Patients may not be as physically active early in the morning, contributing to higher blood sugar levels. This comparison highlights the importance of visualizing data from different times of day, as it allows patients to recognize how their behaviours and schedules impact their glucose levels.

Implications for Self-Management

The value of these visualizations lies in their ability to inform self-management decisions. Data visualizations such as line charts and bar charts provide patients with easily interpretable trends and patterns that enable them to take timely action. By visualizing when their blood sugar levels are most likely to rise, patients can make more informed decisions regarding medication timing, meal planning, and physical activity.

In this case study, the trend of decreasing blood sugar levels (as shown in the line chart) indicates potential improvements in blood sugar management, which can motivate the patient to continue their current regimen. Similarly, the insight into elevated morning blood sugar levels can prompt a discussion with healthcare providers about adjusting mealtimes, medication dosage, or incorporating routine exercises in the morning.

Several studies have demonstrated that patients who engage with data visualizations of their own health data show better long-term outcomes. A study conducted by Dungan and Verma (2023) demonstrated that individuals who regularly visualized their blood sugar data and used apps to track trends had better glycaemic control compared to those who relied on paper records alone. The present findings reinforce the importance of these tools in patient empowerment and clinical decision-making.

Clinical Implications

The findings of this study have significant clinical implications. Understanding the patterns in blood glucose fluctuations is essential for adjusting treatment plans. The morning blood sugar spikes observed in the patient's data could suggest a need for medication adjustments, such as altering the timing of insulin doses or changing the type of insulin used. Furthermore, continuous engagement with data visualizations could enhance the patient's understanding of their own condition, leading to improved glycaemic control.

Limitations of the Study and Areas for Improvement

Although this study provides important insights, several limitations must be addressed. First, the current dataset is relatively small and derived from one individual, which may not capture the full spectrum of blood sugar variability seen across diverse populations. A larger dataset including multiple patients would provide more generalizable insights into blood sugar trends and patterns.

Second, while the Diabetes Data Visualizer app functions well, it is not currently hosted online, limiting its accessibility. Users must run the app locally, which may present challenges for individuals without the necessary technical skills. Hosting the app on a cloud-based platform would allow for real-time data input, remote access, and integration with continuous glucose monitors (CGMs), making it more user-friendly and accessible to a broader population.

Third, the current insights and recommendations are primarily based on trends identified in the line chart of overall blood sugar levels. However, the morning vs. evening comparison bar chart does not currently generate specific insights or recommendations. Enhancing this feature to provide actionable advice based on the time-of-day differences (such as suggesting adjustments to meals or medications based on morning or evening patterns) would improve the app's functionality and its value to users.

Fourth, in this case study, we assumed that the average blood sugar reading of 138.57 mg/dL was postprandial, allowing us to classify it as normal (since the app currently considers 70 to 140 mg/dL as normal, regardless of fasting or postprandial readings). However, without contextual data like mealtimes or activity levels, this assumption introduces a potential limitation in the app's insights. Future improvements to the app could include the ability to input contextual data, such as mealtimes, activity levels, or medications, to more accurately assess blood sugar trends. Additionally, integrating machine learning algorithms could enhance predictive capabilities, helping users detect early signs of hypoglycaemia or hyperglycaemia based on more nuanced factors than simple threshold-based classifications.

CONCLUSION

In conclusion, the Diabetes Data Visualizer demonstrates how effective data visualizations can be in helping patients manage their diabetes more proactively. Through simple visual tools such as line charts and bar charts, patients can recognize trends, assess their progress, and take informed actions to control their blood sugar levels. While the tool shows promise, further improvements and deployment as an online tool would significantly enhance its utility. The ability to generate meaningful insights from simple data visualizations should not be underestimated in improving patient outcomes.

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