Review Article

A Review of Glucose Monitoring Device – Freestyle Libre 3 and its Comparison with Freestyle Libre 1 and 2

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ABSTRACT

The FreeStyle Libre 3 is an advanced continuous glucose monitoring (CGM) system that offers real-time, minute-by-minute glucose data directly to a smartphone, unlike the FreeStyle Libre 1, which required scanning for readings. Compared to the FreeStyle Libre 2, which introduced optional alarms for high and low glucose, the Libre 3 is smaller, more accurate, and provides continuous monitoring without the need for scanning. Its enhanced accuracy and real-time updates improve diabetes management by offering better insights into glucose trends and reducing the risk of hypoglycemic events. Overall, the FreeStyle Libre 3 represents a significant advancement in CGM technology.

Keywords: Glucose Monitoring Device, Freestyle, Libre 1, Libre 2, Libre 3.

INTRODUCTION

The **Freestyle Libre 3** is the latest model in Abbott's series of continuous glucose monitoring (CGM) systems. It represents a significant advancement over previous versions, incorporating enhanced technology to provide users with more accurate and convenient glucose monitoring. Here's an introduction to the **Freestyle Libre 3.**[1]

The **Freestyle Libre 3** is a continuous glucose monitoring system designed to offer real-time, accurate glucose readings with minimal user intervention. It provides a comprehensive solution for individuals with diabetes, helping them manage their condition more effectively and comfortably.[2]

Key Features[2]

1. **Continuous Glucose Monitoring:**

- **Real-Time Data:** The Libre 3 provides continuous glucose readings directly to a smartphone app, offering real-time updates on glucose levels without the need for a separate reader device.

2. **Enhanced Accuracy:**

- **Improved MARD:** The Libre 3 features an improved Mean Absolute Relative Difference (MARD) of approximately 9.2%, providing more precise glucose measurements compared to earlier models.

3. **Automatic and Continuous Data Transmission:**

- **Seamless Connectivity:** The sensor continuously transmits glucose data to the smartphone app without the need for manual scanning. This ensures users have up-to-date information at all times.

4. **Real-Time Alerts:**

- **High and Low Glucose Alerts:** The system provides real-time notifications for both high and low glucose levels, helping users take prompt action to manage their glucose levels and avoid potential complications.

5. **Discreet and Comfortable:**

- **Small and Thin Sensor:** The Libre 3 sensor is smaller and more discreet than previous models, designed for comfort and minimal visibility when worn on the skin.

6. **Long Sensor Life:**

- **Up to 14 Days:** The sensor remains effective for up to 14 days, providing a consistent and long-term solution for glucose monitoring

Applications[2]

- **Diabetes Management:** Ideal for individuals with type 1 or type 2 diabetes who need continuous glucose monitoring.
- **Pregnancy:** Suitable for pregnant women with diabetes, providing a reliable way to monitor glucose levels throughout pregnancy.

Figure 1: Free style libre 3[4]

Libre 3 Sensor Overview[3]

- Purpose: The Libre 3 system is used to monitor glucose levels continuously. It measures glucose in the interstitial fluid (ISF), which is the fluid surrounding cells just below the skin.
- Users: It is approved for individuals aged 4 years and older with either type 1 or type 2 diabetes. This includes pregnant women.
- Caregiver Involvement: For children aged 4 to 12, their caregivers are responsible for managing the device and interpreting glucose data.

INDICATIONS[3]

1. Glucose Monitoring: Measuring glucose levels in the interstitial fluid (ISF) for individuals with diabetes.
2. Age Range: Suitable for people aged 4 years and older.
3. Types of Diabetes: Used for both type 1 and type 2 diabetes, including during pregnancy.
4. Management: Designed to replace routine fingerstick blood glucose monitoring to assist with daily diabetes self-management and therapy adjustments.

It helps track glucose levels continuously, providing insights for managing both acute and long-term diabetes care.

HOW IT WORKS[3]

1. Sensor Placement: A small sensor is applied to the skin, typically on the back of the upper arm.
2. Continuous Monitoring: The sensor measures glucose levels continuously and sends this information to a smartphone app.
3. No Fingersticks Needed: The Libre 3 is designed to replace the need for routine fingerstick blood glucose tests, providing a more convenient way to monitor glucose levels.

MANAGING THE DATA[3]

- Daily Diabetes Management: The system helps users keep track of their glucose levels throughout the day, monitor patterns of highs and lows (hyperglycemia and hypoglycemia), and make adjustments to their diabetes management plan.
- Symptom Check: If the Libre 3 readings do not match what a person feels or expects (e.g., symptoms of low or high blood sugar), it is important to confirm glucose levels with a traditional fingerstick method.

KEY POINTS[3]

- Accuracy: While the Libre 3 provides continuous glucose monitoring, it is crucial to cross-check its readings with fingerstick tests if they do not align with symptoms.
- Flexibility: The system helps in adjusting diabetes management more easily and effectively by tracking glucose trends over time.

Overall, the Libre 3 system aims to simplify glucose monitoring and improve diabetes management by reducing the need for frequent fingerstick tests.

POSSIBLE BENEFITS[5]

1. Continuous Glucose Monitoring: It provides real-time glucose readings without the need for frequent fingersticks, offering a more convenient and less invasive way to track glucose levels throughout the day.
2. Improved Glucose Management: By delivering continuous data, the system helps users and healthcare providers identify trends and patterns in glucose levels, which can lead to better-informed decisions and adjustments in diabetes management.
3. Real-Time Alerts: Users receive immediate notifications if their glucose levels are too high or too low, allowing for quicker action to prevent severe hypoglycemia or hyperglycemia.
4. Convenience: The sensor is small and worn discreetly on the skin, making it easier to use compared to traditional blood glucose monitoring methods.
5. Reduced Fingerstick Testing: While occasional fingersticks are still recommended to confirm readings, the need for routine blood glucose checks is significantly reduced, which can improve user comfort and compliance.
6. Data Integration: The Libre 3 app can sync with other health apps and devices, providing a comprehensive view of health data and enhancing overall diabetes management.
7. Enhanced Insight: The system tracks glucose levels continuously, helping users understand how their glucose levels change in response to food, exercise, and medication.
8. Support for Adjustments: The detailed glucose data can aid healthcare providers in making more precise adjustments to insulin doses or other treatment plans, potentially improving long-term outcomes.

These advantages collectively help in managing diabetes more effectively and comfortably, enhancing the overall quality of life for users.

POSSIBLE DRAWBACKS[5]

The Libre 3 sensor system, while offering several benefits, also has some possible drawbacks:

1. Accuracy Variability: The sensor measures glucose in the interstitial fluid, which can sometimes lag behind blood glucose levels, especially during rapid changes in glucose levels. This may lead to occasional

discrepancies between sensor readings and actual blood glucose levels.

2. Interference with Certain Medications or Conditions: Some medications or medical conditions may affect sensor accuracy or performance. Users need to be aware of how their health conditions or treatments might impact the sensor.
3. Cost: The Libre 3 system can be expensive, and not all insurance plans may cover the cost, potentially making it less accessible for some individuals.
4. Skin Irritation: Some users may experience skin irritation or allergic reactions at the site where the sensor is applied.
5. Calibration Needs: While the Libre 3 requires fewer calibrations compared to some glucose monitoring systems, occasional fingerstick tests are still necessary to verify readings, which can be inconvenient.
6. Data Connectivity Issues: Users may experience issues with the app or connectivity problems between the sensor and the smartphone, affecting the ease of accessing glucose data.
7. Sensor Lifespan: The sensor has a limited lifespan (typically around 14 days), and users need to replace it regularly, which might be a hassle for some.
8. Limited Information on Hypoglycemia: The sensor may not always provide adequate warning for rapid drops in glucose levels, so users should remain vigilant and monitor symptoms as well.

These potential drawbacks should be considered alongside the advantages to ensure that the Libre 3 system is a suitable choice for managing individual diabetes care.

COST[6]

The cost of the **Libre 3** system varies depending on the region, insurance coverage, and specific retailer. On average, in the U.S., the sensor itself typically costs around $70 to $100 per sensor, which lasts for about 14 days. Additionally, there may be costs for the reader or app-compatible devices if not already owned. Insurance coverage can significantly impact out-of-pocket expenses, so it's best to check with insurance providers or local health services for more precise information.

In India, the cost of the **Libre 3** sensor generally ranges from ₹4,000 to ₹5,000 per sensor, which lasts about 14 days. Prices may vary based on the retailer and location, and insurance coverage may not always apply. It's a good idea to check with local suppliers or healthcare providers for the most current pricing and availability.

Comparing the **Libre 1, Libre 2,** and **Libre 3** sensors highlights advancements in continuous glucose monitoring technology over time. Here's a detailed comparison:[6]

Libre 1

- **Launch Year:** 2014
- **Sensor Duration:** Up to 14 days
- **Glucose Measurement:** Measures glucose in the interstitial fluid (ISF).
- **Accuracy:** Mean Absolute Relative Difference (MARD) of around 11-12%.
- **Calibration:** Requires periodic fingerstick calibrations.
- **Data Access:** Requires a separate reader device to scan the sensor and view glucose data.
- **Features:** Basic continuous glucose monitoring with no real-time alerts or alarms. Data must be scanned manually.

Libre 2

- **Launch Year:** 2018
- **Sensor Duration:** Up to 14 days
- **Glucose Measurement:** Measures glucose in the ISF.
- **Accuracy:** Improved MARD of around 9.4%.
- **Calibration:** No routine fingerstick calibrations required; accuracy is generally good without routine calibrations.
- **Data Access:** Users can scan the sensor with a reader device or a smartphone app. Real-time data is available through the app.
- **Features:** Introduced real-time glucose alerts and alarms for high and low glucose levels. Offers more immediate feedback on glucose levels compared to Libre 1.

Libre 3

- **Launch Year:** 2021
- **Sensor Duration:** Up to 14 days
- **Glucose Measurement:** Measures glucose in the ISF.
- **Accuracy:** Further improved MARD of around 9.2%.
- **Calibration:** No routine fingerstick calibrations needed; however, occasional checks are recommended if sensor readings do not align with symptoms.
- **Data Access:** Continuous real-time glucose monitoring via a smartphone app with automatic updates. No need for a separate reader device.
- **Features:** Provides continuous glucose readings with real-time, automatic alerts for high and low glucose levels. It is smaller, more discreet, and provides improved connectivity and user experience compared to previous models.

Summary of Differences:

1. **Accuracy:** Each successive model has shown improvements in accuracy, with the Libre 3 being the most precise.
2. **Calibration:** The Libre 3 and Libre 2 have eliminated the need for routine fingerstick calibrations, unlike the Libre 1.
3. **Data Access:** The Libre 3 allows continuous real-time monitoring directly through a smartphone app, whereas the Libre 1 required a separate reader, and the Libre 2 allowed both reader and smartphone app use.
4. **Alerts and Features:** The Libre 2 introduced real-time alerts, while the Libre 3 provides continuous automatic alerts and a more streamlined, user-friendly experience.
5. **Size and Discreetness:** The Libre 3 is smaller and more discreet compared to its predecessors.

Overall, each iteration of the Libre system has built upon the previous models to provide enhanced accuracy, user convenience, and real-time data management.

CONCLUSION

The FreeStyle Libre 3 offers improved accuracy, a smaller sensor, and real-time glucose readings directly to your smartphone. With continuous monitoring and no need for scanning, it provides a more convenient and reliable way to manage diabetes. It's a top choice for those seeking an advanced, hassle-free glucose tracking solution. The FreeStyle Libre 1 introduced a simple, cost-effective way to monitor glucose with periodic scanning. The Libre 2 enhanced this with improved accuracy and optional alarms for high/low glucose levels, offering more proactive management. The Libre 3 is the most advanced, featuring continuous, real-time glucose monitoring, a smaller sensor, and seamless integration with smartphones for easier, more convenient diabetes management. Each iteration has built on the last, with the Libre 3 offering the most accurate, user-friendly, and comprehensive experience.

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