CarbInsulinAssist

Dissemination Seminar - Monday 9th June 2025

Introduction

This presentation summarises the results of the **CarbInsulinAssist** project, funded by the Mauritius Research and Innovation Council (MRIC).

The project aimed to develop a mobile application Minimum Viable Product (MVP) to assist individuals with Type 1 Diabetes in Mauritius with insulin dosage calculations based on meal intake.

Developed from **June 2024** to **February 2025**, the CarbInsulinAssist application allows users to input meal details and receive suggested insulin dosages.

It outlines the project's methodology, key achievements, and the potential for future impact on diabetes management in Mauritius.

Objectives

The CarbInsulinAssist project was fundamentally focused on the creation and initial validation of a technology-based solution. The development of a mobile application represent key milestones in achieving this objective. The success of this project phase is measured by the completion of a functional MVP and the establishment of a foundation for future evaluation of its impact on Type 1 Diabetes management in Mauritius.

The main features of the MVP were to be able to:

- Determine Carbohydrates through Food scanning
- Make Insulin dose recommendations based on carbohydrates identified in food and user current glycemic level
- Store Meal consumed & Glucose readings in a log

Deviations noted during Carbohydrate Counting Workshop (without CarbInsulinAssist)

Wrong Estimates and Computations

- Portion Weight Estimation
- Carbohydrate Estimation
- Insulin Dose Computation in normoglycemia conditions
- Insulin Dose Computation in hyperglycemia conditions

Examples of Food used during the Workshop

Deviations noted during Carbohydrate Counting Workshop (without CarbInsulinAssist)

Correlation Check

Correlation between % deviation in portion weight estimation and % deviation in carbohydrate estimation: **0.94**

Interpretation:
Strong correlation → participants who overestimate weights tend to overestimate carbs, and vice versa.

This suggests that improving portion size estimation would directly improve carbohydrate estimation accuracy.

Deviations noted during Carbohydrate Counting Workshop (without CarbInsulinAssist)

Conclusions

- Very low % of participants were within recommended ranges
- Tendency to under-dose for both Hyper and normoglycemia conditions
- Mixed dishes amplify errors
- Need to focus on improving confidence and accuracy in dose calculation

Mitigation Measures

CarbInsulinAssist is part of a system, not just an APP

The system comprises of the following key attributes:

- **CarbInsulinAssist** mobile App
- **Nutrition Education** (Carbohydrate counting, Macronutrients, Portion size…)
- **Therapeutic Education** (CHO, Hypo, Hyper, Insulin Dosing and Injection sites…)
- **Medical & Paramedical Support & Assistance** (Diabetologist, General Doctor, Dietician, Diabetes Educator, Counsellor, Psychologist, …)
- **Equipment** (Glucometer, Insulin, Glucagon & Electronic scale for user)

Demo Video

Deliverables

Objectives of the project

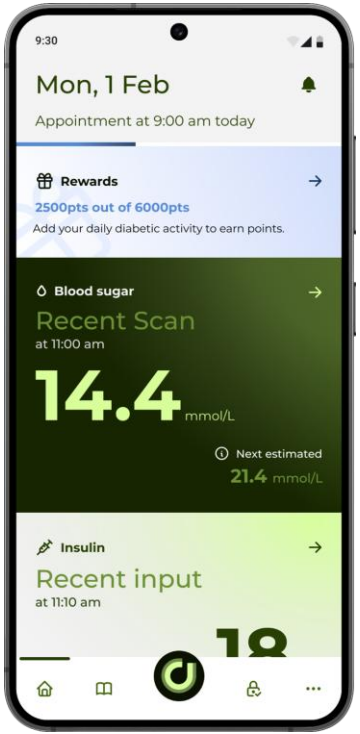
Objectives	Status
Personae Develop detailed user personae representing typical individuals with Type 1 Diabetes in Mauritius to guide design and development.	Completed
Service BluePrint Create a service blueprint outlining the user journey and key touchpoints within the CarbInsulinAssist application and supporting services.	Completed
Design Prototypes Design interactive prototypes of the mobile application to visualize user interface and user experience flows.	Completed
Food Recognition Module (Camera) Develop a functional Food Recognition Module utilizing the device camera to enable users to identify food items.	Completed
Insulin Recommendation Engine Develop a robust Insulin Recommendation Engine capable of calculating and suggesting appropriate insulin dosages based on identified food and user parameters.	Completed
Data capture & logs (Journal module) Implement data capture and logging capabilities within a Journal Module to record user inputs, application usage, and relevant data for user tracking and potential research purposes.	Completed
Progressive Web App Changed tech stack to be able to test across different devices and OS (Android and iOS). MVP is available through the web and can be installed as a PWA.	Completed

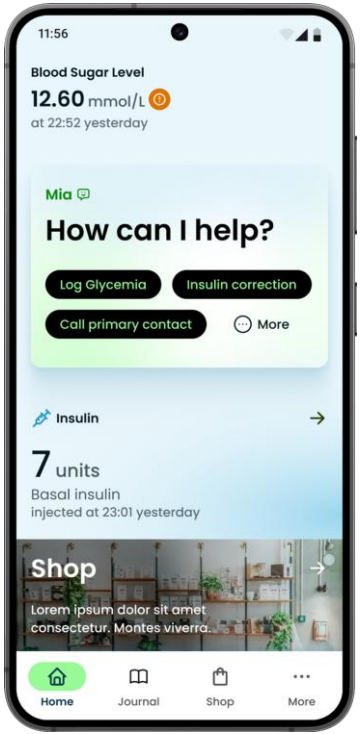
Objectives of the project

Objectives	Status
Glucometer integration Explore and implement integration with common glucometer devices to enable seamless data input and enhance user convenience	Not completed Technical challenges
Doctor's Dashboard Develop a Doctor's Dashboard to provide healthcare professionals with an interface to monitor patient data	Partially completed
User Data Dashboard for research Develop a User Data Dashboard for research purposes, allowing for anonymized data aggregation and analysis	Partially completed
Mauritian Food Library Curate a comprehensive Mauritian Food Library within the application to ensure accurate food recognition and carbohydrate estimation for local diets.	Early estimation

Design Evolution

4 main iterations

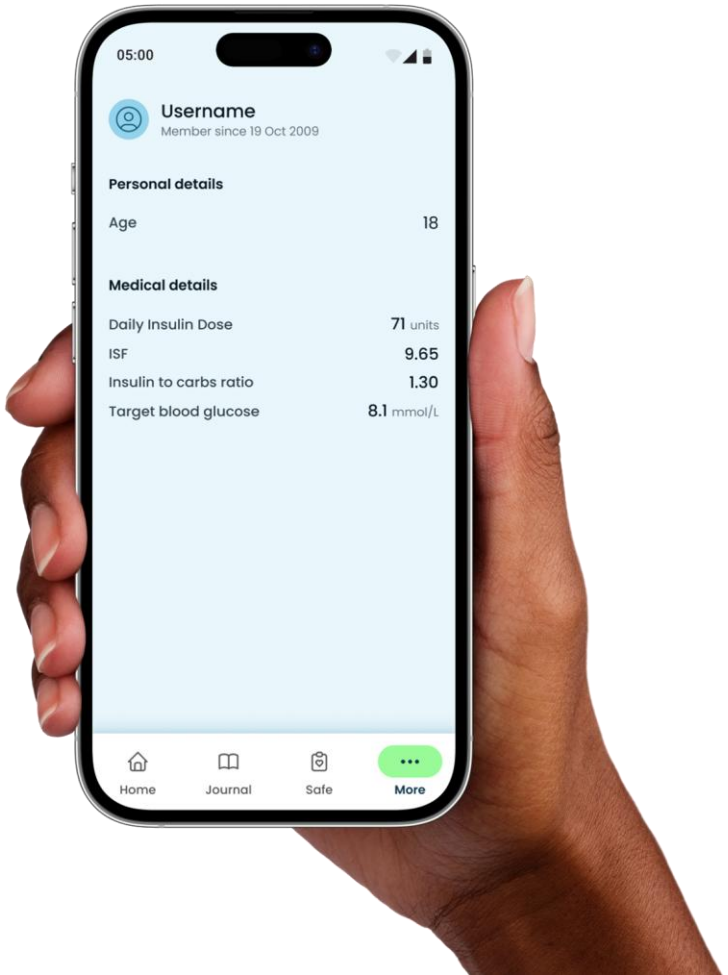




Profile

The CarbInsulinAssist app includes a profile section where users can manage their personal information relevant to diabetes management.

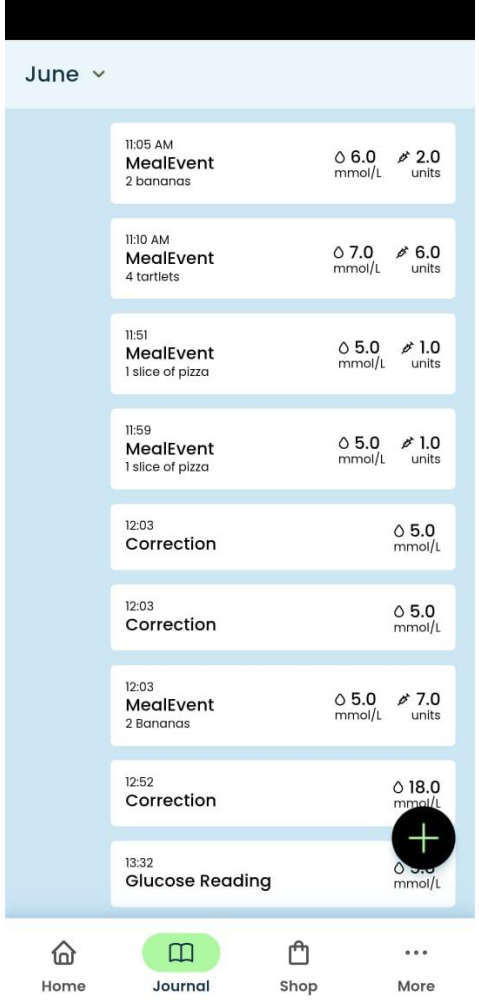
Upon logging in, users can access their profile and update details such as Insulin Sensitivity Factor (ISF), Insulin to Carbs Ratio (ICR), Target blood glucose and Total Daily (Insulin) Dose (TDD).

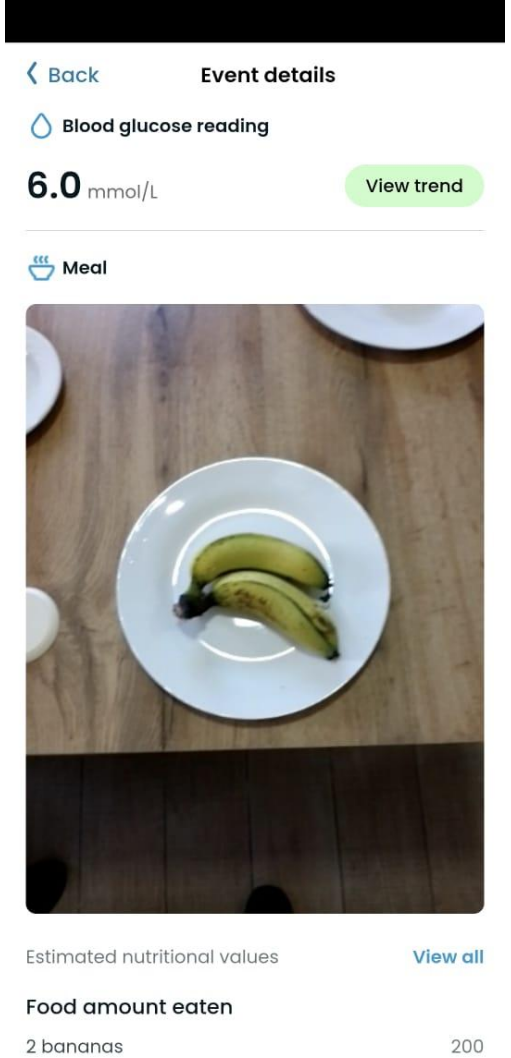


Journal

The app's journal feature that replaces the traditional log book used by individuals with T1DM. Through interactions with the app, information is automatically recorded in the journal, providing users with a comprehensive overview of their daily diabetes management activities.

Additionally, users will be able to manually log other relevant information, such as exercise or specific events, that may impact their blood glucose levels.





Food detection to Insulin Recommendation

Our app simplifies daily diabetes management with a clear, guided process:

Log Meal: Users begin by selecting the "Log Meal" option in the app.

Capture Blood Glucose: First, they take their blood glucose reading, and the app automatically integrates this data.

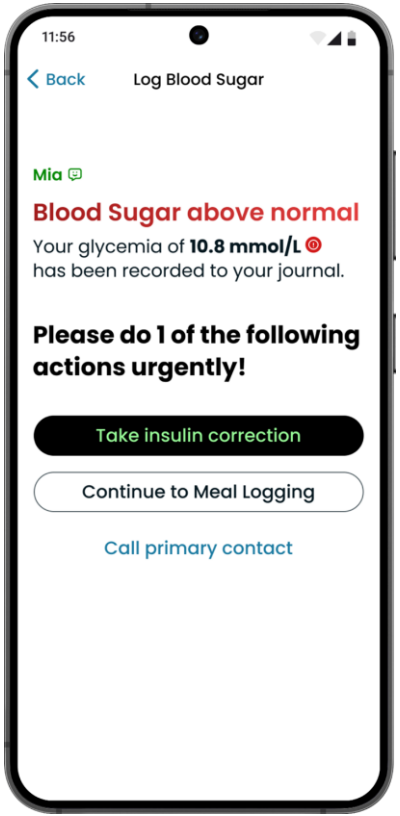
Capture Meal: Next, users take a picture of their meal. The app's Food Detection Module analyzes the image to identify food items and estimate carbohydrate content.

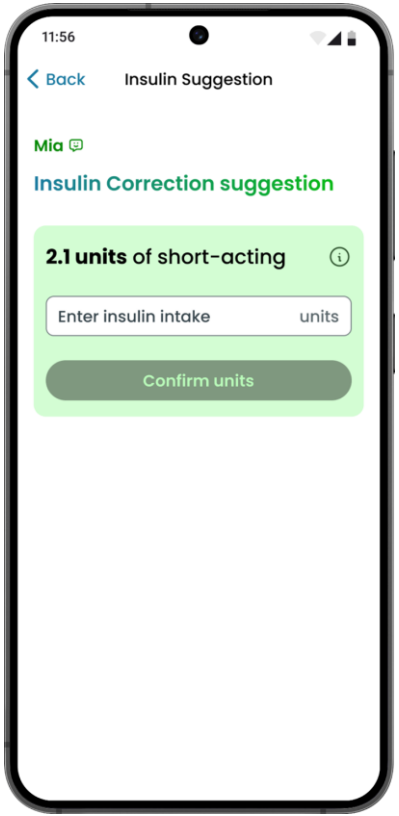
Personalized Calculation: Based on the blood glucose reading, the detected meal's carbohydrates, and the user's personalized profile settings (ISF, ICR, Target BG), the app instantly calculates a suggested insulin dose.

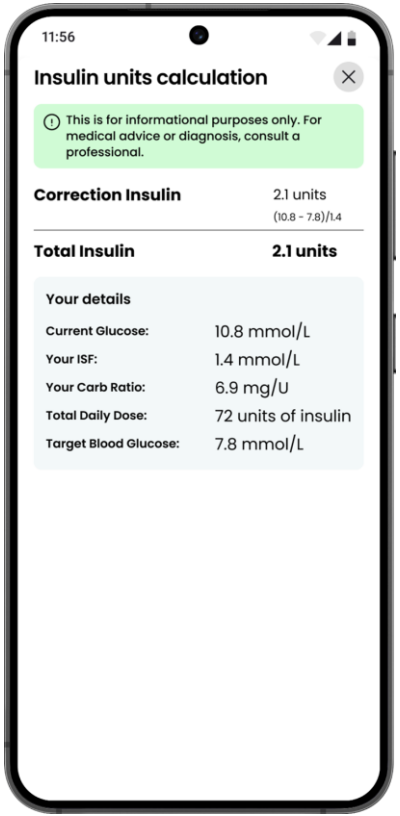
This streamlined flow minimizes manual effort and provides immediate, data-driven insulin recommendations, including corrections.

Support in Managing Diabetes for Hypoglycemia

Support in Managing Diabetes for Hyperglycemia







Challenges Encountered

Challenges encountered

The CarbInsulinAssist project, while successful in achieving its core objectives, encountered certain challenges during its development. These primarily were:

- Technical Challenges with Large Language Models
- API Outage
- Mauritian Food Detection & Food Library
- Glucometer Integration

Technical Challenges with Large Language Models

Challenge 1: Large Language Model (LLM) Output Consistency

Difficulty in Prompt Engineering: It was a time-consuming, trial-and-error process to craft effective prompts to get the desired output from the LLM agents.

Extracting Structured Data: The raw, text-based output from the LLMs wasn't directly usable. We had to develop specific methods to parse, structure, and validate numerical data for the application's core functions, which added to development time.

Challenge 2: Google Gemini API Outage

Critical Integration Failure: Near the project's end, a global outage of the Google Gemini API, which powered our Food Detection Module, threatened a core functionality.

Emergency API Switch: We had to quickly integrate the OpenAI API as an alternative. This unplanned effort took extra days for re-integration, prompt re-tuning, and rigorous testing to ensure the application remained functional.

Mauritian Food Detection

We've started developing a dedicated food database to store information for every food item our app detects.
Each entry includes:

- Food image
- Name
- Nutritional values

This database helps us understand the subtle differences between similar foods. Our goal is to find a balance between the AI-generated nutritional data and expert nutritional analysis.

Initial feedback from nutritionists indicates that the AI currently tends to predict nutritional values on the higher end of the spectrum. This highlights an important area for ongoing refinement and calibration of our own Food Library models.

Mauritian Food Library

To provide a reliable solution for Mauritian Type 1 Diabetics, we need to build a dedicated, local food library for CarbInsulinAssist.

User-Centric Development: "Made by *T1 Diams, for *T1 Diams" ensures the library meets their specific need.

Controllable Data: Unlike "black box" AI, our data is meticulously curated, allowing for transparency and accurate updates.

Lab-Tested & Validated Values:

- Extensive Image Collection: Gathering diverse images of Mauritian dishes for accurate identification.
- Dedicated Testing Team: A specialized team will manage lab testing of food samples for precise macronutrient content.
- Expert Validation: Local dieticians and doctors have reviewed and validated all data, ensuring accuracy and safety for users.

* people living with type 1 diabetes

Glucometer Integration

The Challenge with Manufacturer SDKs

Outdated SDKs: A significant hurdle is that glucometer manufacturers often do not keep their Software Development Kits (SDKs) up-to-date. This makes direct integration a complex and time-consuming process.

We are still in active discussions with SinoCare to finalize their integration and are also exploring other alternative solutions and manufacturers to broaden our device compatibility.

Focus on Alternative Data Entry Methods

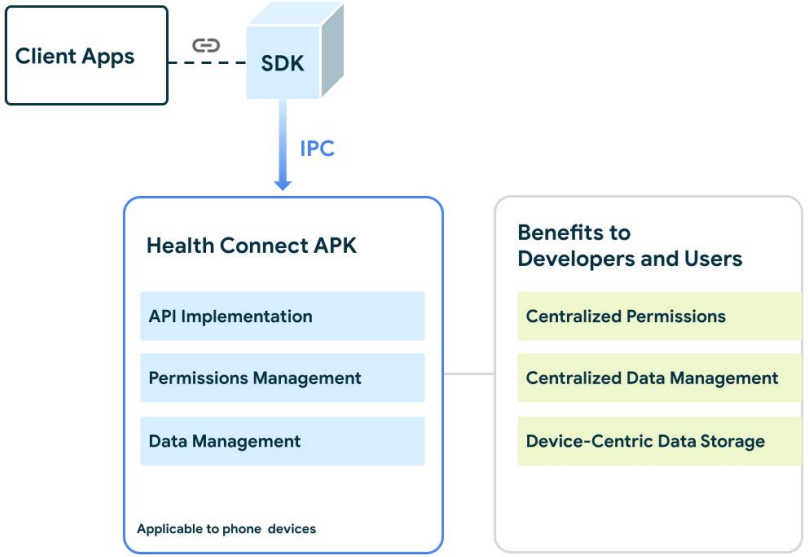
Photo Capture: Users can photograph their glucometer readings.
Manual Entry: Users can manually input their blood glucose values.

Glucometer Integration (Other option)

During the milestone 3 report, it was mentioned the potential integration of Google Health Connect.

Upon submission of the report, SinoCare replied with all necessary tools to make integration possible.

SinoCare was opted as direct integration is preferred over middleman type integration.



Source: Google Health Connect

The Next Steps

Nurturing Collaborations

To ensure the long-term sustainability, security, and scalability of CarbInsulinAssist, we have successfully approached and secured engagement from a major local IT company. This partnership provides crucial support in two key areas:

Technical Architecture support (e.g. servers hosting)
It encompasses robust server hosting solutions, ensuring the app is reliable, scalable, and performs optimally as our user base grows.

Security and GDPR Compliance
Given the sensitive nature of health data (blood glucose levels, insulin doses, dietary information), data security and user privacy are paramount.

Our partner provides critical support in implementing industry-best security practices to protect user data from unauthorized access and breaches.

Securing Funding for a National Impact

We have already submitted a comprehensive continuation project proposal to the Mauritius Research and Innovation Council (MRIC).

This funding is critical to consolidate the Minimum Viable Product (MVP) you've seen today, transforming it into a robust and sustainable solution.

The primary and most vital focus of this proposed continuation is the development of a comprehensive Mauritian Food Library. This national resource will be the cornerstone for accurate, localized, and safe diabetes management for all Mauritians.

Your support will enable us to build this essential foundation and deliver a truly impactful health innovation for our nation.

Thank you