



An-Najah National University
Faculty of Engineering & Information Technology

Graduation Project 1

T1D

Type 1 Diabetes



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Disclaimer

This report was written by Dania Shashtare and Rama Abu Ghdeeb at the Computer Engineering Department, Faculty of Engineering and Information Technology, An-Najah National University. It has not been altered other than editorial corrections.

Abstract

T1D, which stands for Type 1 Diabetes, is a healthcare follow-up application designed to support patients with Type 1 Diabetes in managing their daily health routine in an organized and accessible way. The system provides tools for glucose tracking, meal logging, reports, appointments, notifications, and communication with healthcare providers.

The application supports multiple user roles, including patients, doctors, nutritionists, family members, and administrators. Patients can record glucose readings, track meals, view reports, book appointments, and communicate with doctors and nutritionists. Doctors can monitor assigned patients, review glucose data, manage appointments, and provide medical follow-up. Nutritionists can create meal plans and follow patient progress, while family members can monitor patient safety and receive important alerts. The admin role manages users and approves healthcare providers.

The system was developed using Flutter for the frontend, Node.js and Express.js for the backend, MongoDB for data storage, and Firebase for notifications and real-time alert support. The application also includes multi-language support for Arabic and English, dark mode, role-based access control, and secure password management.

Overall, T1D aims to make diabetes care easier, safer, and more organized by connecting patients, healthcare providers, and family members within one integrated platform.

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Chapter 1 — Introduction

1.1 General Background

Type 1 Diabetes is a chronic health condition that requires continuous daily monitoring and careful management. Patients with Type 1 Diabetes need to regularly track their blood glucose readings, meals, insulin-related routines, physical activity, medical appointments, and overall health status. Any delay or lack of organization in monitoring these elements may affect the patient's health and make diabetes management more difficult.

In many cases, patients depend on separate methods to manage their condition, such as notebooks, phone reminders, messaging applications, or manual communication with doctors and nutritionists. This can lead to scattered information, missed readings, forgotten appointments, and difficulty in sharing accurate health data with healthcare providers. Family members may also find it difficult to monitor the patient's condition, especially when immediate alerts or updates are needed.

With the development of mobile and web technologies, digital health applications have become useful tools for improving chronic disease management. These applications help patients organize their health data, communicate with specialists, receive reminders, and view reports that summarize their condition over time.

T1D, which stands for Type 1 Diabetes, is a healthcare follow-up application designed to support patients with Type 1 Diabetes and improve communication between patients, doctors, nutritionists, family members, and administrators. The system provides an integrated platform that includes glucose tracking, meal logging, reports, appointments, notifications, chat, family monitoring, and user management. By combining these services in one system, T1D aims to make diabetes care easier, safer, and more organized.

1.2 Project Objectives

The main objective of T1D is to provide an integrated healthcare platform that supports Type 1 Diabetes patients in managing their daily health routine while allowing healthcare providers and family members to follow up more effectively. The objectives of the project are divided according to user roles as follows:

For Patients

- Provide a simple and organized interface for patients to manage their diabetes-related information.
- Allow patients to record and track blood glucose readings.
- Help patients classify glucose readings as low, normal, or high.
- Enable patients to log meals and follow their daily food intake.

- Provide health reports that summarize glucose readings over different time periods.
- Allow patients to book appointments with doctors and nutritionists.
- Support communication with doctors and nutritionists through chat.
- Provide profile management for personal and medical information.
- Support settings such as password change, Arabic and English language options, and dark mode.

For Doctors

- Provide doctors with a dashboard to manage and monitor assigned patients.
- Allow doctors to view patient glucose readings and health reports.
- Help doctors follow up on patient health status in a clearer and more organized way.
- Enable doctors to manage appointments with patients.
- Support communication between doctors and patients through chat.

For Nutritionists

- Provide nutritionists with a dashboard to follow up with assigned patients.
- Allow nutritionists to create and manage meal plans for patients.
- Help nutritionists review patient progress and provide nutrition-related guidance.
- Enable nutritionists to manage appointments with patients.
- Support communication between nutritionists and patients through chat.

For Family Members

- Allow family members to monitor the patient's glucose status.
- Provide quick access to the patient's latest glucose reading and health condition.
- Send alerts and notifications when important health updates occur.
- Help family members support the patient and respond when needed.

For Administrators

- Provide administrators with tools to manage system users.
- Allow administrators to approve doctors and nutritionists before they can use the system.
- Monitor user accounts and system activity.
- Support safe and organized management of the platform.

1.3 Project Significance

T1D represents an important digital solution for supporting patients with Type 1 Diabetes by bringing several healthcare follow-up services into one platform. Instead of relying on separate tools for glucose tracking, meal logging, appointments, reports, and communication, T1D provides a centralized system that organizes these features in a clear and accessible way.

The significance of the T1D project can be summarized as follows:

- **Improved Diabetes Follow-up:** The system helps patients record glucose readings, track meals, and view reports that summarize their health status over time.
- **Better Communication:** T1D improves communication between patients, doctors, and nutritionists by providing direct chat and appointment management.
- **Family Monitoring:** The system allows family members to monitor patient status and receive important alerts, which increases patient safety.
- **Organized Medical Data:** Patient information, readings, reports, appointments, and meal plans are stored in one system, making follow-up easier for both patients and healthcare providers.
- **Multi-role Healthcare Support:** T1D is not limited to patients only. It includes doctors, nutritionists, family members, and administrators, making it a complete follow-up environment.
- **Accessibility and Usability:** The application supports Arabic and English languages, dark mode, and user-friendly interfaces to improve accessibility for different users.

Overall, T1D contributes to making diabetes management more organized, safer, and easier by using modern mobile and web technologies to connect patients with their healthcare support network.

1.4 Organization of the Report

This report is organized into six chapters as follows:

- **Chapter One** introduces the T1D project, including the general background, project objectives, project significance, and the organization of the report.
- **Chapter Two** presents the theoretical background and related work relevant to diabetes monitoring systems, healthcare applications, and digital follow-up platforms.
- **Chapter Three** describes the methodology of the system, including the tools, technologies, architecture, programming languages, and the implementation of the main system features.
- **Chapter Four** presents the results and analysis of the T1D system, including the outcomes of the patient, doctor, nutritionist, family member, and admin interfaces.

- **Chapter Five** discusses the project goal achievement, actual contribution, strengths, and limitations.
- **Chapter Six** concludes the report and presents recommendations, future expansion opportunities, and open work.

Chapter 2 — Theoretical Background and Related Work

2.1 Theoretical Background

Type 1 Diabetes is a chronic medical condition in which the body is unable to produce enough insulin. As a result, patients need continuous follow-up and daily management to keep their blood glucose levels within a safe range. Managing Type 1 Diabetes usually requires regular glucose monitoring, meal organization, appointment follow-up, medical communication, and awareness of health changes that may require immediate attention.

Patients with Type 1 Diabetes often face difficulties in organizing their daily health routine. Blood glucose readings may be recorded in different places, meal information may not be tracked consistently, and communication with doctors or nutritionists may depend on phone calls or external messaging applications. This makes the follow-up process less organized and may make it harder for healthcare providers to understand the patient's condition clearly.

With the development of mobile and web technologies, healthcare applications have become useful tools for supporting chronic disease management. These applications help patients record medical information, receive reminders, view health reports, and communicate with healthcare providers in a more structured way. Digital health systems can also improve the relationship between patients, doctors, nutritionists, and family members by making health data easier to access and follow.

Notifications and alerts are also important in diabetes management. Since blood glucose levels can become too high or too low, patients and their family members may need quick updates when an important health change occurs. A system that supports real-time alerts can help improve patient safety, especially when family members are involved in monitoring the patient's condition.

In addition, health reports play an important role in understanding the patient's progress over time. By organizing glucose readings and meal records into reports, patients and healthcare providers can better identify patterns, review health status, and make more suitable decisions. Therefore, combining glucose tracking, meal logging, reports, appointments, notifications, and communication tools in one platform can make diabetes management easier and more effective.

2.2 Related Work

Several healthcare applications have been developed to support diabetes patients in managing their daily health routines. Many existing applications focus mainly on recording blood glucose readings and displaying simple statistics. These systems help patients keep track of their glucose levels, but they may not provide full support for communication with doctors, nutritionists, and family members.

Some diabetes management applications provide meal tracking features, allowing users to record food intake and review their daily nutrition. Other applications focus on reminders and notifications, such as reminding patients to check their glucose level, take medication, or attend

medical appointments. Although these features are useful, they are often limited to one part of the diabetes management process.

There are also healthcare platforms that allow communication between patients and doctors. These systems help patients receive medical advice remotely and reduce the need for frequent physical visits. However, many of these platforms are general healthcare systems and are not specifically designed for Type 1 Diabetes follow-up. As a result, they may not include features such as glucose classification, diabetes reports, family monitoring, or nutritionist follow-up.

Some systems support family involvement by allowing caregivers to receive updates about the patient's condition. This is especially useful for young patients or patients who need continuous support. However, these systems are usually separated from appointment management, nutrition planning, and doctor communication features.

Overall, many existing systems provide useful diabetes-related services, but most of them focus on separate features. A patient may need to use one application for glucose tracking, another application for meal logging, another tool for appointments, and external applications for communication. This separation can make diabetes management more complicated and less efficient.

2.3 Relevance to the T1D Application

The T1D application was developed to reduce the limitations found in separate diabetes management tools. Instead of focusing on only one feature, T1D combines several important healthcare follow-up services in one integrated platform. The system supports glucose tracking, meal logging, reports, appointments, notifications, chat, family monitoring, and user management.

T1D is designed to support multiple user roles, including patients, doctors, nutritionists, family members, and administrators. Patients can record glucose readings, track meals, view reports, book appointments, and communicate with healthcare providers. Doctors can monitor patient glucose data, review reports, manage appointments, and provide medical follow-up. Nutritionists can follow patient progress and create meal plans, while family members can monitor the patient's health status and receive important alerts. Administrators are responsible for managing users and approving healthcare providers.

The application also improves organization by storing patient health information in one system. This makes it easier for patients to follow their daily routine and easier for healthcare providers to review the patient's condition. The availability of reports helps summarize glucose readings over time, while appointments and notifications help users stay updated and avoid missing important medical tasks.

In addition, T1D supports accessibility and usability through features such as Arabic and English language support, dark mode, and role-based interfaces. These features make the system easier to use for different types of users and help provide a more comfortable experience.

By using modern technologies such as Flutter, Node.js, Express.js, MongoDB, and Firebase, T1D provides a flexible and scalable healthcare follow-up system. The application can be improved in the future by adding more advanced health analysis, smart recommendations, and integration with medical devices. Therefore, T1D represents a practical digital solution that

makes Type 1 Diabetes care more organized, connected, and safer.

Chapter 3 — Methodology

3.1 Tools, Technologies, Architecture, and Programming Languages

This chapter presents the methodology followed in the development of the T1D application. It explains the tools, technologies, system architecture, programming languages, and frameworks used to build the system. In addition, it describes the implementation of the main system features according to the different user roles, including patients, doctors, nutritionists, family members, and administrators.

The T1D system was developed as an integrated healthcare follow-up platform for Type 1 Diabetes patients. The application supports several functions such as glucose tracking, meal logging, reports, appointments, notifications, chat, family monitoring, provider approval. The system was designed to make diabetes care more organized by connecting patients with healthcare providers and family members within one platform.

3.1.1 Tools

The development of the T1D application relied on several tools that supported coding, testing, database management, API testing, and collaboration. These tools helped in building the frontend, backend, database, and notification services in an organized way.

- **Visual Studio Code:** Used as the main development environment for writing and editing the frontend and backend code. It was used to manage Flutter files, Node.js backend files, routes, controllers, and configuration files.
- **Android Studio Emulator:** Used to test the mobile application during development on a simulated Android device. This helped check the design, navigation, responsiveness, and functionality of the mobile screens.
- **Flutter SDK:** Used to build and run the mobile application. Flutter helped create a cross-platform user interface with reusable widgets and smooth navigation between screens.
- **Node.js:** Used to run the backend server and handle the main system logic. It allowed the backend to manage users, authentication, appointments, glucose readings, meal plans, reports, chat requests.
- **Express.js:** Used as the backend framework for building RESTful API endpoints. It helped organize routes, handle HTTP requests, apply middleware, and connect the frontend with the backend services.
- **MongoDB:** Used as the main database for storing system data, including users, patient information, glucose readings, meals, appointments, chats, meal plans, and notifications.

- **Mongoose:** Used to define database schemas and interact with MongoDB in a structured way. It helped organize the data models for different entities such as patients, doctors, nutritionists, appointments, and other system records.
- **Postman:** Used to test backend API endpoints before connecting them to the frontend. It helped verify that requests and responses were working correctly for authentication, appointments, users, and other features.
- **Firebase Cloud Messaging:** Used to support notifications and real-time alerts. This helped send important updates to users, such as appointment reminders, glucose alerts, and family notifications.
- **GitHub:** Used for version control and project backup. It allowed the development team to manage code updates, track changes, and maintain separate repositories for the frontend and backend.

3.1.2 Architecture Diagram

The architecture of the T1D application is designed using a layered structure that separates the user interface, backend services, database, and external services. This structure improves maintainability, scalability, and organization of the system.

The interaction begins from the client side, where users access the application through a mobile interface developed using Flutter. Each user role has access to specific screens and features based on their permissions. Patients can record glucose readings, log meals, view reports, book appointments, and communicate with healthcare providers. Doctors and nutritionists can monitor patients, manage appointments, and communicate with them. Family members can monitor patient status and receive alerts, while administrators can manage users and approve healthcare providers.

When a user performs an action, such as signing in, adding a glucose reading, booking an appointment, sending a message, the request is sent from the Flutter application to the backend through RESTful API calls. The backend, developed using Node.js and Express.js, receives the request, validates the data, checks user permissions, and routes the request to the correct controller or service.

The backend communicates with MongoDB through Mongoose models. The database stores all important system data, including user accounts, health records, glucose readings, meal logs, appointments, chats, meal plans, provider approval status. This allows the system to retrieve and update data when needed.

Firebase Cloud Messaging is integrated with the system to support notifications and alerts. When an important event occurs, such as a new appointment, a health alert, or a message notification, the system can send a notification to the appropriate user. This improves communication and helps users stay updated.

The overall architecture of T1D supports role-based access control, secure authentication, organized data management, and future expansion. New features such as smart glucose analysis, device integration, or advanced health recommendations can be added later without changing the entire system structure.

3.1.3 Programming Languages and Frameworks

The T1D application was developed using several programming languages and frameworks to support both frontend and backend development.

The frontend of the system was developed using **Dart** with the **Flutter** framework. Flutter was selected because it supports cross-platform mobile application development and provides a flexible way to build user-friendly interfaces. The application includes multiple screens for different user roles, such as patients, doctors, nutritionists, family members, and administrators. Flutter widgets were used to create forms, dashboards, reports, appointment pages, chat interfaces, settings pages, and profile screens.

The backend of the system was developed using **JavaScript** with **Node.js** and **Express.js**. Node.js was used to run the server-side logic, while Express.js was used to create API routes and handle requests between the frontend and backend. The backend is responsible for authentication, role-based access control, user management, glucose tracking, appointment management, chat handling, meal plan management, notifications.

For data storage, the system uses **MongoDB**, a NoSQL database that stores data in flexible document-based collections. This makes it suitable for storing different types of healthcare-related data such as users, glucose readings, meals, appointments, messages, and notifications. **Mongoose** was used with MongoDB to define schemas and manage database operations in a more organized way.

The system also uses **Firebase Cloud Messaging** to support notifications. Firebase helps deliver real-time alerts to users, especially for important updates related to patient monitoring, appointments, and communication.

Overall, the combination of Flutter, Node.js, Express.js, MongoDB, Mongoose, and Firebase provides a complete full-stack environment for building the T1D healthcare follow-up application.

3.2 Features Implementation

3.2.1 Authentication Screens

Signin Screens

The Signin screen allows registered users to access the T1D application securely by entering their email address and password. The screen is designed with a simple and clear interface that contains an email field, password field, login button, forgot password option, and a Google sign-in option.

The authentication screen uses two main tabs: Sign In and Sign Up. In the Sign In tab, the user enters the email and password, then presses the Login button. Before sending the request to the backend, the application checks that both fields are not empty. If one of the fields is missing, the system displays an error message asking the user to enter the required login information.

When the user submits the login form, the application sends the email and password to the backend using the login API endpoint. The backend checks the credentials and returns the user information if the login is successful. After that, the application stores the user ID and role

locally using SharedPreferences. This allows the application to remember the logged-in user and redirect them correctly.

After successful signin, the system redirects the user according to the stored role. If the user is a patient, the application opens the patient home screen. If the user is a doctor, it opens the doctor dashboard. If the user is a nutritionist, it opens the nutritionist dashboard. If the user is a family member, the system retrieves the linked patient information first, then opens the family home screen. This role-based navigation helps ensure that every user reaches the correct interface and can only access the features related to their role.

The signin process also supports saving the user notification token using Firebase Notification Service. This step helps the system send notifications and alerts to the correct user after login. If the entered email or password is incorrect, the backend returns an error response, and the application displays an error message such as “Invalid email or password”. This prevents unauthorized access and informs the user that the login information is not valid.

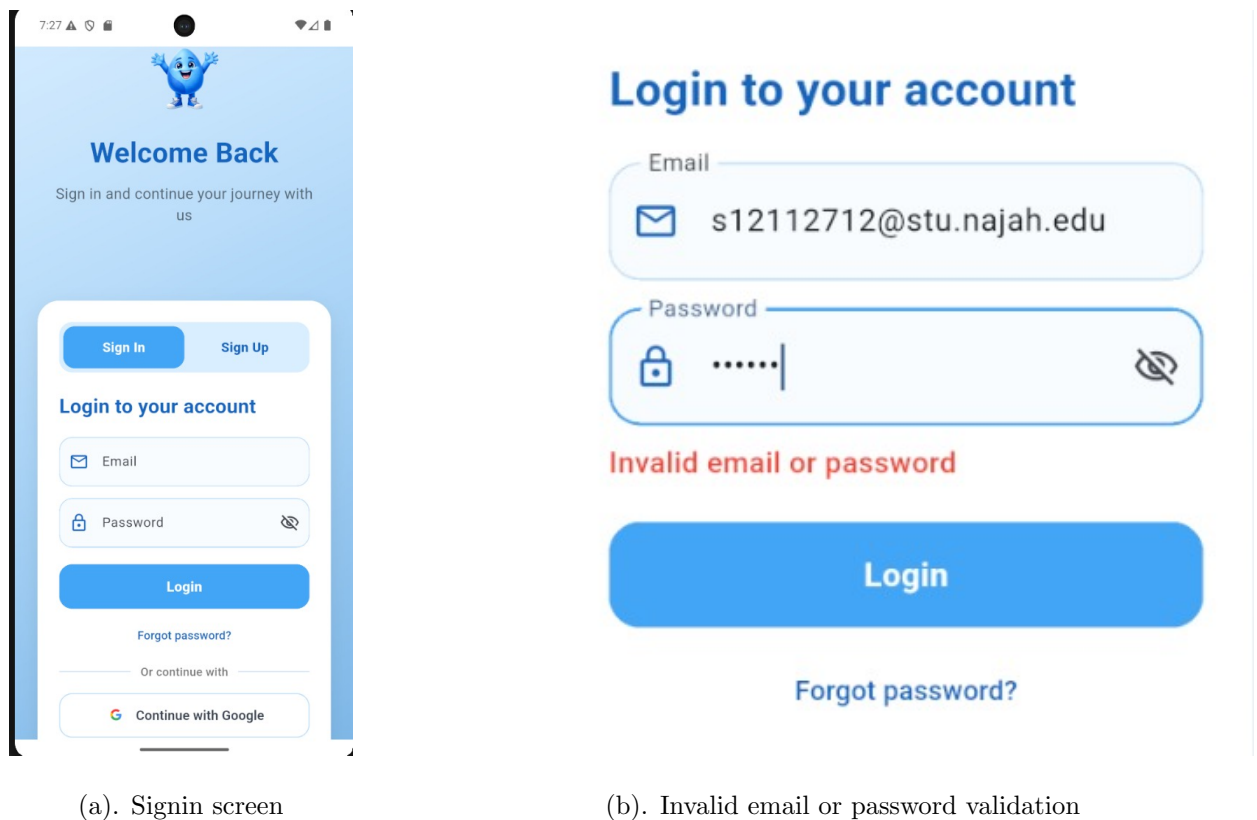


Figure 3.1: Signin Screens in the T1D application

In addition to the normal email and password login, T1D supports signing in using Google. When the user presses the Continue with Google button, the application opens the Google account selection screen. The user selects a Google account, and the application authenticates the account using Firebase Authentication and Google Sign-In.

After Google authentication is completed, the application sends the Google email to the backend to check whether this user already exists in the T1D database. If the account exists, the system retrieves the user role and redirects the user to the correct home page. If the account does not exist, the system fills the signup form with the Google account information and asks the user to

complete account creation. This makes Google sign-in easier while still keeping the role-based structure of the application.

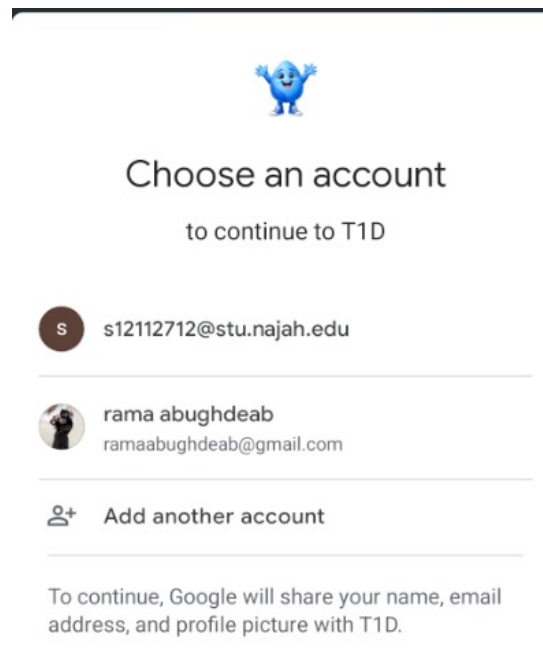
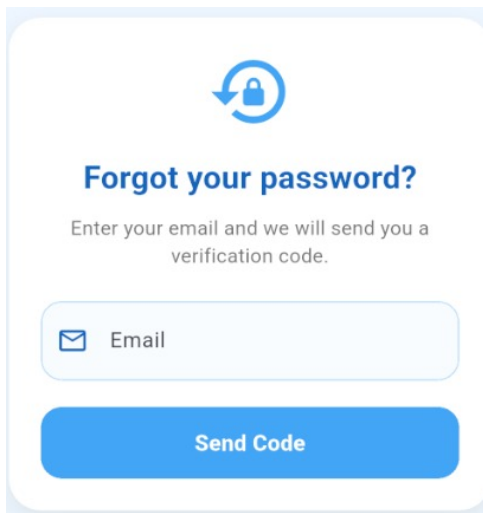


Figure 3.2: Continue with Google account selection

The Signin screen also includes a Forgot Password option for users who cannot remember their password. When the user presses Forgot password, the application navigates to the Forgot Password screen. This screen asks the user to enter the registered email address. After pressing Send Code, the application sends a request to the backend forgot-password endpoint.

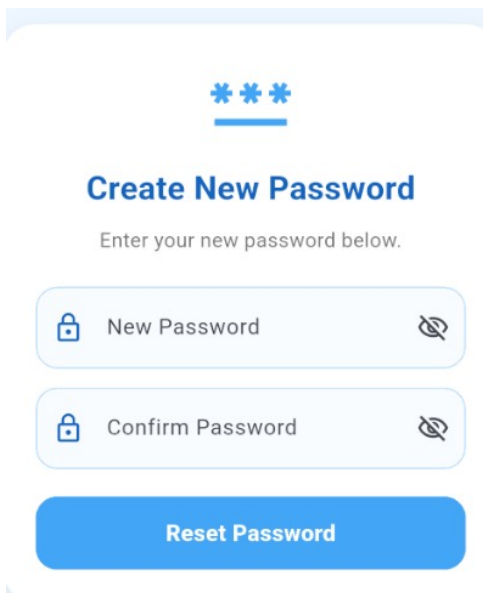
If the email is valid, the backend sends a password reset code to the user's email. The application then navigates to the verification step, where the user enters the received code. After the code is verified, the user can create a new password by entering and confirming the new password. The reset password request is then sent to the backend, and if the process is successful, the user can sign in again using the new password.

This password recovery process improves usability because users can recover their accounts without needing direct administrator support. It also improves security because the password reset depends on a verification code sent to the registered email.



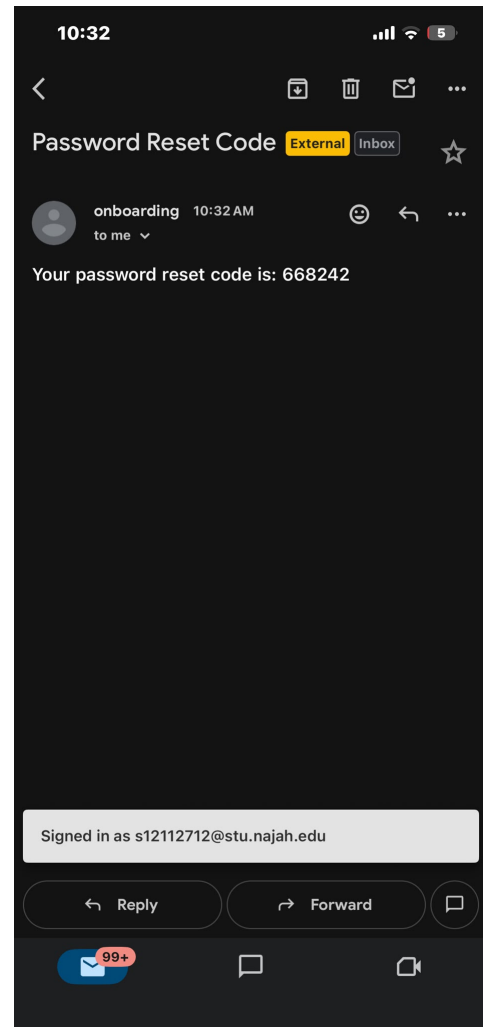
The screen features a blue circular icon with a padlock and a refresh arrow at the top. Below it, the title "Forgot your password?" is displayed in bold blue text. A subtitle reads "Enter your email and we will send you a verification code." There is a light blue input field with an envelope icon and the placeholder text "Email". Below the input field is a prominent blue button labeled "Send Code".

(a). Forgot password screen



The screen has a blue header with three asterisks. The title "Create New Password" is in bold blue text, followed by the instruction "Enter your new password below." There are two light blue input fields: the first is labeled "New Password" with a lock icon and a toggle to show/hide the password; the second is labeled "Confirm Password" with a lock icon and a toggle. A blue button labeled "Reset Password" is at the bottom.

(c). Create new password screen



(b). Password reset code received by email

Figure 3.3: Forgot Password and Reset Password Screens in the T1D application

Signup Screens

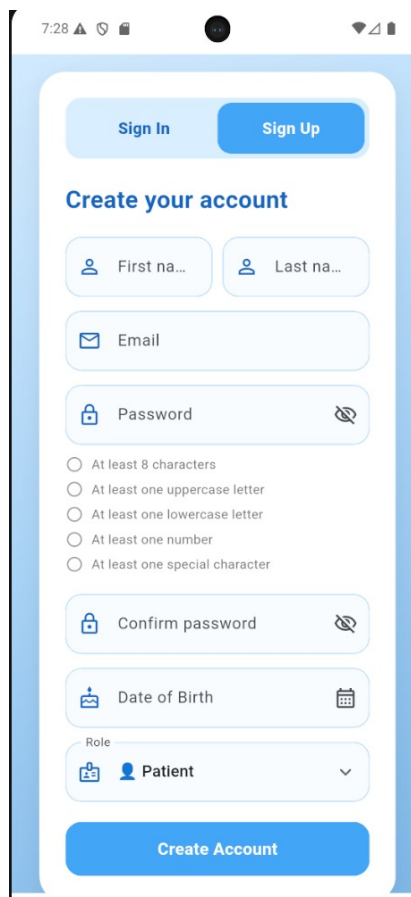
The Signup screen allows new users to create an account in the T1D application. The screen is designed to support different user roles within the same authentication interface. The user can switch between the Sign In and Sign Up tabs, then complete the registration form by entering the required account information.

During signup, the user is required to enter first name, last name, email address, password, confirm password, date of birth, and role. The available roles are Patient, Doctor, Nutritionist, and Family Member. The role selection is important because the system uses it to redirect each user to the correct onboarding form after account creation.

The signup form includes several validation rules to improve security and data quality. The system checks that all required fields are filled, the password and confirm password match, and

the password is strong enough. The password strength rules require at least eight characters, one uppercase letter, one lowercase letter, one number, and one special character. The application also checks if the entered email already exists in the system and displays a suitable error message if the email is already used.

After the signup request is submitted, the data is sent to the backend through the signup API. If the account is created successfully, the system receives the created user information and redirects the user to a role-specific onboarding screen. This step allows the system to collect additional information depending on the selected role. For example, patients complete diabetes-related medical questions, doctors and nutritionists complete professional verification forms, and family members complete patient-linking information.



(a). Signup form



(b). Role selection

Figure 3.4: Signup Screens in the T1D application

Patient Onboarding Form After creating a patient account, the user is redirected to the Patient Onboarding screen. This form collects important medical and diabetes-related information that helps the application provide better follow-up and monitoring. The patient questions were prepared after consulting diabetes doctors and specialists to make sure that the collected information is relevant to Type 1 Diabetes care and useful for future follow-up.

The patient onboarding form includes general patient information such as height, weight, and diagnosis date. These fields help provide basic medical context for the patient's profile. If the patient is 12 years old or younger, the system automatically shows a Guardian Information section. This section asks for guardian name, relationship, and guardian phone number, because younger patients usually need parent or caregiver support.

The form also includes Treatment and Medications questions. The patient can select one or more treatment types, such as rapid insulin, basal insulin, mixed insulin, insulin pump, pills, or other treatment. If the patient chooses Other, the system displays an additional field to enter the treatment name. This makes the form flexible for different treatment routines.

Another important part of the form is the Diabetes Management section. The patient selects how they manage diabetes, such as Carb Counting, Fixed Doses, or I Don't Know. If the patient selects Fixed Doses, the form asks for breakfast dose, lunch dose, dinner dose, Lantus dose, Lantus time, and correction factor. If the patient selects Carb Counting, the form asks for carb ratio, Lantus dose, Lantus time, and correction factor. These questions help the system understand the patient's daily diabetes management method.

The final part is the Food Allergy section. The patient can specify whether they have food allergies. If the answer is yes, the system asks for allergy details. This information is important because nutrition recommendations and meal planning should consider food restrictions.

Patient Onboarding

Complete Your Information
Patient profile form



Patient Information

↑ Height (cm)

Weight (kg)

Diagnosis Date

(a). Patient basic information



Treatment & Medications

What types of treatment do you use?
You can select more than one option


Rapid


Basal


Mixed

(b). Treatment and medications



Diabetes Management

How do you manage diabetes?
Select one option



Food Allergy

Do you have food allergies?

(c). Diabetes management



Food Allergy

Do you have food allergies?

 Allergy Details

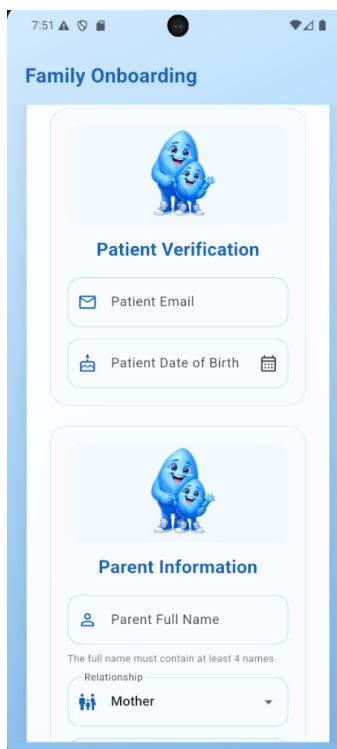
(d). Food allergy

Figure 3.5: Patient Onboarding Questions in the T1D application

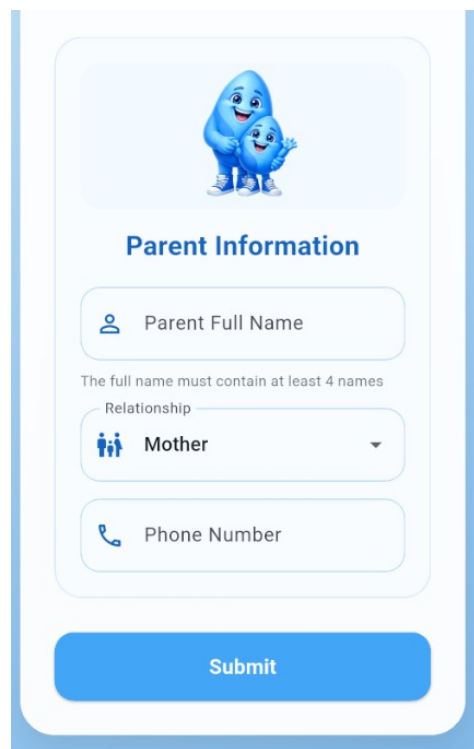
Family Member Onboarding Form After creating a family member account, the user is redirected to the Family Onboarding screen. The purpose of this form is to link the family member account with an existing patient account so the family member can monitor the patient’s status and receive important alerts.

The form is divided into two main sections. The first section is Patient Verification. In this section, the family member enters the patient’s email address and date of birth. The system uses this information to check whether the patient account exists and to prevent linking the family member to the wrong patient.

The second section is Parent Information. It collects the family member’s full name, phone number, and relationship to the patient. The relationship options include Mother, Father, Sibling, Relative, and Caregiver. The system validates the parent information and requires the full name to contain at least four names. This helps keep the family profile clear and reliable. If the patient is 12 years old or younger, the system handles the case differently. If a patient account already exists, the family member is guided to use the patient login. If the patient account does not exist, the system asks the user to create a patient account first. This logic helps organize child patient accounts and family monitoring correctly.

The screenshot shows the 'Family Onboarding' screen with a blue header. Below the header is a section titled 'Patient Verification' with a blue cartoon character icon. It contains two input fields: 'Patient Email' with an envelope icon and 'Patient Date of Birth' with a calendar icon. Below this is another section titled 'Parent Information' with the same blue cartoon character icon. It contains a 'Parent Full Name' input field with a person icon, a note 'The full name must contain at least 4 names', a 'Relationship' dropdown menu with 'Mother' selected and a family icon, and a 'Phone Number' input field with a phone icon. A large blue 'Submit' button is at the bottom.

(a). Patient verification

The screenshot shows the 'Family Onboarding' screen with a blue header. Below the header is a section titled 'Parent Information' with a blue cartoon character icon. It contains a 'Parent Full Name' input field with a person icon, a note 'The full name must contain at least 4 names', a 'Relationship' dropdown menu with 'Mother' selected and a family icon, and a 'Phone Number' input field with a phone icon. A large blue 'Submit' button is at the bottom.

(b). Family member information

Figure 3.6: Family Member Onboarding Questions in the T1D application

Doctor Onboarding Form After creating a doctor account, the user is redirected to the Doctor Onboarding screen. This form collects professional information and verification documents before allowing the doctor account to be used fully. This step supports platform safety because doctors should be reviewed before interacting with patients.

The doctor onboarding form includes Basic Professional Information, such as full name, phone number, workplace, and specialty. The full name must contain at least four names. The specialty field includes options such as Endocrinologist, Pediatric Endocrinologist, Internal Medicine, General Physician, Diabetes Specialist, and Other. If the doctor selects Other, the system shows an additional field to enter the specialty manually.

The Professional Details section asks for years of experience, the age groups the doctor follows, and whether the doctor treats Type 1 Diabetes patients. The age group options include Children, Adolescents, Adults, and All Ages. At least one age group must be selected. If the doctor answers that they do not treat Type 1 Diabetes patients, the system displays an information message explaining that the application is intended for Type 1 Diabetes patients.

The Professional Verification section asks the doctor to upload professional proof, such as a degree, certificate, or other professional document. Uploading professional proof is required. The doctor can also upload a CV as an optional file. These files help the administrator review and approve the doctor account.

(a). Basic professional information

(b). Professional details

(c). Professional verification

Figure 3.7: Doctor Onboarding Questions in the T1D application

Nutritionist Onboarding Form After creating a nutritionist account, the user is redirected to the Nutritionist Onboarding screen. This form collects professional nutrition information and verification documents. The purpose of this step is to make sure that nutritionist accounts are completed and ready for administrator review before being used to support patients.

The nutritionist onboarding form includes Basic Professional Information, such as full name, phone number, workplace, and specialty. The specialty options include Clinical Nutrition, Diabetes Nutrition, Pediatric Nutrition, Therapeutic Nutrition, Sports Nutrition, and Other. If Other is selected, the system displays an additional field to enter the specialty manually.

The Professional Details section asks for years of experience, the age groups the nutritionist follows, whether they have experience with Type 1 Diabetes patients, and the usual meal planning approach. The age group options include Children, Adolescents, Adults, and All Ages. The meal planning approach can be Carb Counting, Calories Based, Weight Goals, Mixed Approach, or Other. If Other is selected, the system asks the nutritionist to enter the planning approach manually.

The Professional Verification section asks the nutritionist to upload professional proof, such as a degree, certificate, or professional document. This upload is required before submitting the form. The nutritionist can also upload a CV as an optional file. These documents help the administrator review and approve the nutritionist account.

The screenshot shows the 'Complete Nutritionist Information' section of the onboarding form. It features a blue header with the title 'Nutritionist Onboarding' and a sub-header 'Complete Nutritionist Information'. Below the sub-header is a prompt: 'Please complete your professional details below.' A cartoon character is displayed above the 'Basic Professional Information' section. This section contains four input fields: 'Full Name' (with a note 'The full name must contain at least 4 names'), 'Phone Number', 'your workplace (town_c...', and 'Specialty' (with a dropdown menu currently showing 'Clinical Nutrition').

(a). Basic professional information

The screenshot shows the 'Professional Details' section of the onboarding form. It features a blue header with the title 'Nutritionist Onboarding' and a sub-header 'Professional Details'. A cartoon character is displayed above the section. The section contains four input fields: 'Years of Experience', 'Age Groups You Follow' (with checkboxes for 'Children', 'Adolescents', 'Adults', and 'All Ages'), 'Do you have experience with Typ...' (with a dropdown menu currently showing 'Yes'), and 'How do you usually build meal p...' (with a dropdown menu currently showing 'Carb Counting').

(b). Professional details

The screenshot shows the 'Professional Verification' section of the onboarding form. It features a blue header with the title 'Nutritionist Onboarding' and a sub-header 'Professional Verification'. A cartoon character is displayed above the section. The section contains two input fields: 'Upload Professional Proof' (with a note 'Degree or professional proof') and 'Upload CV (Optional)' (with a note 'You can upload your CV'). Both fields have 'Upload File' buttons. A blue box at the bottom states: 'The selected file will be uploaded from your laptop and saved in the database.' A large blue 'Submit' button is at the bottom.

(c). Professional verification

Figure 3.8: Nutritionist Onboarding Questions in the T1D application

3.2.2 Use T1D as a Patient

The patient side is the main part of the T1D application because it is the part used daily by the person with Type 1 Diabetes. It was designed to help the patient record glucose readings, understand the current glucose status, follow glucose changes during the day, and receive guidance when the glucose level becomes low or high.

The patient interface focuses on simplicity, clear colors, and direct actions. The application does not only store glucose readings, but also analyzes the reading value, classifies it into a medical status, updates the glucose chart, and redirects the patient to the correct follow-up screen when needed.

Patient Home Page and Glucose Chart

The Patient Home Page gives the patient a daily overview of their glucose status. It displays a welcome message, the current glucose value, the unit mg/dL, the current glucose status, the last reading time, a 24-hour chart, and an input field for adding a new glucose reading.

The current glucose card is updated according to the latest valid reading. If no reading exists, the page displays a message telling the patient that no readings have been added yet. When the patient adds a new glucose reading, the application sends the value to the backend, saves it in the database, reloads the readings, and updates the home page immediately.

The glucose status is determined using clear thresholds. If the reading is below 70 mg/dL, the status is considered low. If the reading is greater than 180 mg/dL, the status is considered high. If the reading is greater than 140 mg/dL and less than or equal to 180 mg/dL, it is considered slightly high. Otherwise, the reading is considered in range.

The application also changes the color of the reading according to the glucose value. Readings below 70 mg/dL and above 180 mg/dL are displayed in red because they need attention. Readings between 141 and 180 mg/dL are displayed in orange because they are slightly high. Readings between 70 and 140 mg/dL are displayed in green because they are considered within the normal range.

The 24-hour chart was implemented using the `fl_chart` package. Each glucose reading is converted into a point on the chart. The x-axis represents the time of the day, while the y-axis represents the glucose value in mg/dL. The x value is calculated from the reading time using the following formula:

$$x = hour + \frac{minute}{60} + \frac{second}{3600}$$

For example, if a glucose reading was recorded at 8:30 AM, the x value becomes:

$$x = 8 + \frac{30}{60} = 8.5$$

The y value is the glucose value itself. Therefore, a reading of 120 mg/dL at 8:30 AM becomes a chart point close to:

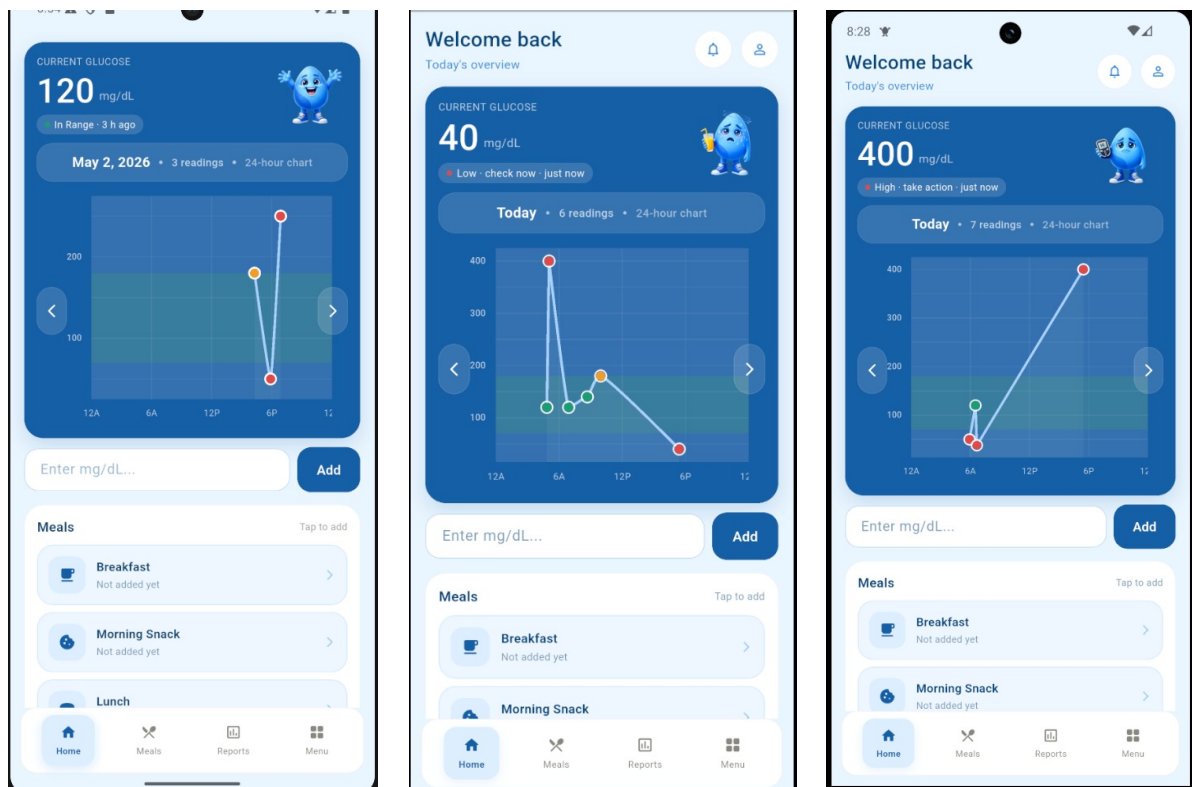
$$(8.5, 120)$$

This allows the chart to show the glucose changes across the full day from 0 to 24 hours. Before drawing the chart, the application prepares the readings to avoid misleading results. First, the readings are sorted by time. If more than one reading exists in the same second, the application keeps the latest one only. This prevents duplicated readings from appearing on the chart.

The application also checks for suspicious glucose jumps. A suspicious jump means that the value changed too much in a very short time, which may happen because of wrong input. For example, if the difference between two readings is 120 mg/dL or more within two minutes, the reading is considered suspicious. Also, if the glucose value changes at a rate of 60 mg/dL per minute within five minutes, it is also considered suspicious. Suspicious readings are ignored on the chart so they do not distort the glucose curve.

The chart limits are also calculated dynamically. The minimum y value is based on the lowest visible reading, with an additional margin below it. The maximum y value is based on the highest visible reading, with an additional margin above it. This makes the chart easier to read because it adapts to the patient's actual readings instead of using a fixed scale all the time.

The chart can display readings for different days. The user can move between today, yesterday, tomorrow, or any selected day. For each selected day, the application filters the readings and displays only the readings that belong to that day.



(a). Patient home page with glucose chart

(b). Chart after low glucose reading

(c). Chart after high glucose reading

Figure 3.9: Patient Home Page and Glucose Chart

Low Glucose Handling

Low glucose is one of the most important cases handled by the patient side. When the patient enters a glucose reading below 70 mg/dL, the application classifies the reading as low and redirects the patient to the Low Glucose screen. This screen was designed to help the patient act quickly and safely.

The Low Glucose screen receives the glucose value, the reading ID, the patient ID, and the patient weight. The patient weight is important because the application uses it to calculate the required amount of fast carbohydrates. The formula used in the application is:

$$\text{Required Carbohydrates} = \text{Patient Weight (kg)} \times 0.3$$

The result is then rounded to the nearest whole number. For example, if the patient weight is 50 kg, the required carbohydrates are calculated as:

$$50 \times 0.3 = 15g$$

This means the patient needs approximately 15 grams of fast-acting carbohydrates.

After calculating the needed carbohydrates, the application provides treatment suggestions. These suggestions help the patient choose a fast carbohydrate option such as juice, glucose tablets, regular soda, or honey. The application is not limited to fixed suggestions only. It calls an AI-based suggestion service through the backend by sending the required carbohydrates and the patient weight. The AI service returns suitable treatment options including the food or drink title, amount, carbohydrate value, and an image query.

To make the suggestions more understandable, the application also tries to load a related image for each suggestion. It uses the image query returned with the suggestion to search for a suitable food or drink image. This improves the user experience because the patient can recognize the suggested treatment more easily.

If the AI suggestion request fails, the application still provides backup treatment options. This is important because low glucose is an urgent case, and the patient should not be left without guidance if the AI service or internet request fails. The backup options are calculated according to the required carbohydrate amount. For example, the application can estimate the amount of orange juice, number of glucose tablets, amount of regular soda, or honey portion based on the required carbohydrate value.

The patient can choose one of the suggested options or select the Other option. If the patient selects Other, they can write what they actually ate or drank. This is useful because the patient may treat the low glucose using food that is not listed in the suggestions.

When the patient confirms the treatment, the application saves the selected treatment with the glucose reading. The saved data can include the treatment type, selected food title, amount, carbohydrate value, custom text if the patient used the Other option, and whether the reminder was enabled. This connects the low glucose event with the action taken by the patient.

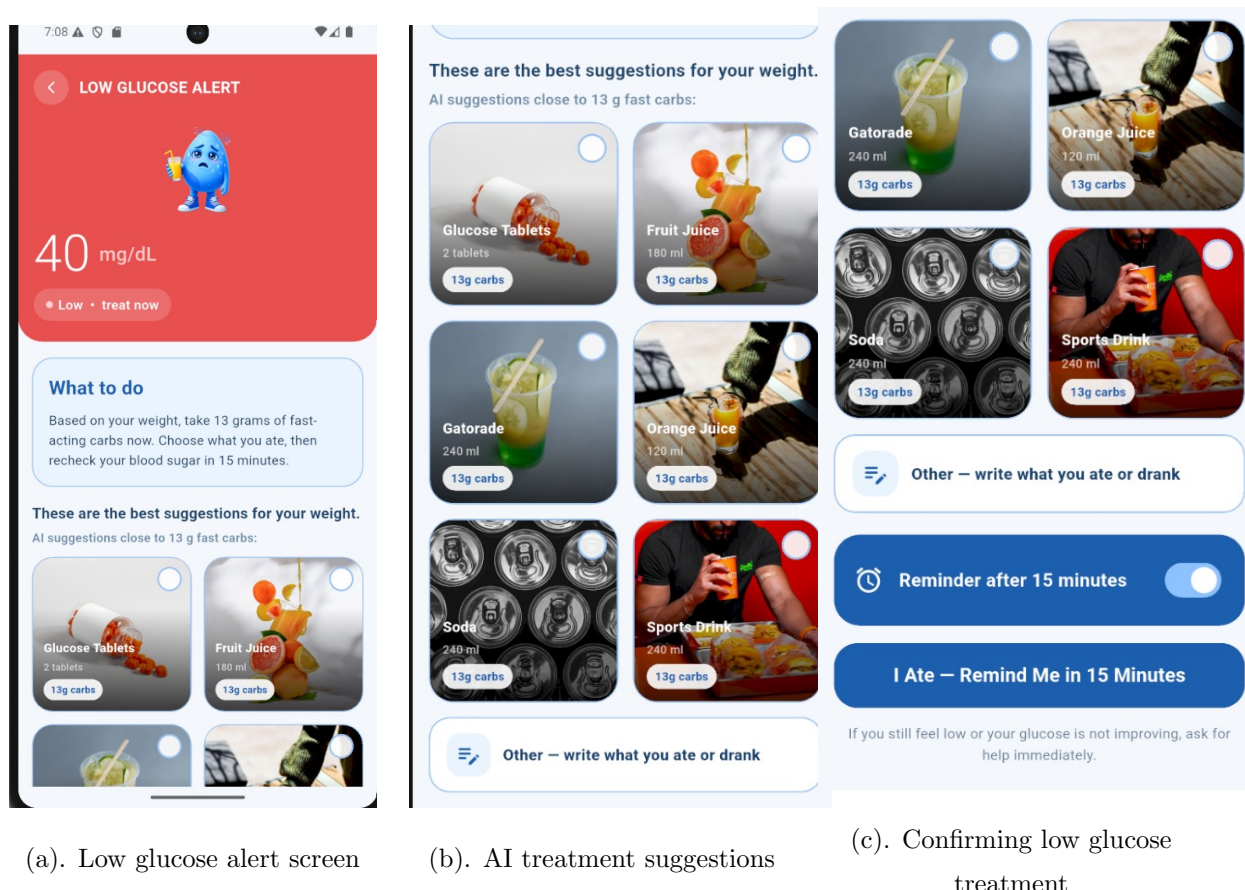
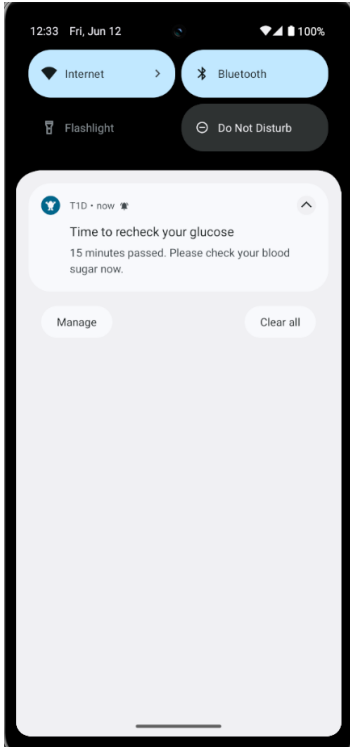


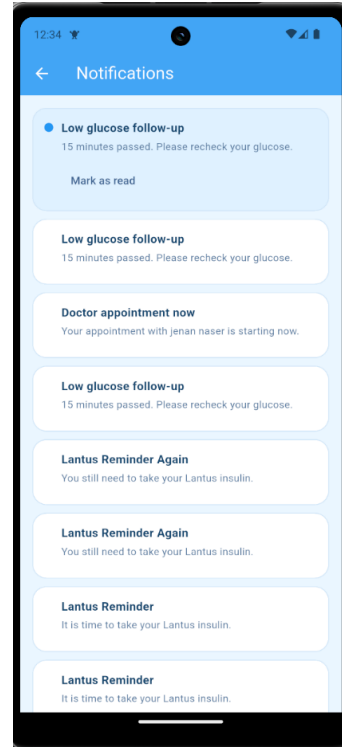
Figure 3.10: Low Glucose Handling and Treatment Suggestions

Low Glucose Follow-up Notifications

The low glucose screen includes a reminder option. This reminder is used only for the low glucose case. When the patient confirms the treatment and keeps the reminder enabled, the application schedules a follow-up reminder to ask the patient to recheck glucose after 15 minutes. The purpose of this reminder is to support the common diabetes safety rule of rechecking glucose after treating hypoglycemia. The application shows a confirmation message telling the patient that the treatment was saved and that they will be reminded to check their glucose again. The notification is handled in two ways. First, the application shows a local notification on the device using the notification service. Second, the application saves the notification to Firebase Firestore using the Firebase notification service. Saving the notification in Firestore allows the notification to appear later inside the notifications screen of the application. The saved notification includes a title, body, user ID, and notification type. For the low glucose follow-up case, the notification title is related to low glucose follow-up, and the message asks the patient to recheck glucose after the waiting period. This makes the notification specific to the low glucose event and avoids mixing it with other types of notifications.



(a). Low glucose follow-up notification



(b). Low glucose notification inside the app

Figure 3.11: Low Glucose Follow-up Notifications

High Glucose Handling

High glucose is handled separately from low glucose because the required action is different. When the patient enters a glucose reading greater than 180 mg/dL, the application classifies the reading as high and redirects the patient to the High Glucose screen.

The High Glucose screen displays the glucose value clearly with a warning design. It also shows information explaining that the glucose level is high and that correction may be needed depending on the patient's care plan. The goal of the screen is to help the patient understand the situation without replacing medical advice.

The application can calculate a suggested correction dose if the patient has a correction factor stored in their profile. The correction factor represents how much one unit of insulin is expected to lower the glucose level. The application also uses a target glucose value. In the system, the default target glucose value is 120 mg/dL.

The correction dose is calculated using the following formula:

$$\text{Suggested Dose} = \frac{\text{Current Glucose} - \text{Target Glucose}}{\text{Correction Factor}}$$

For example, if the current glucose is 260 mg/dL, the target glucose is 120 mg/dL, and the correction factor is 50, the suggested dose is:

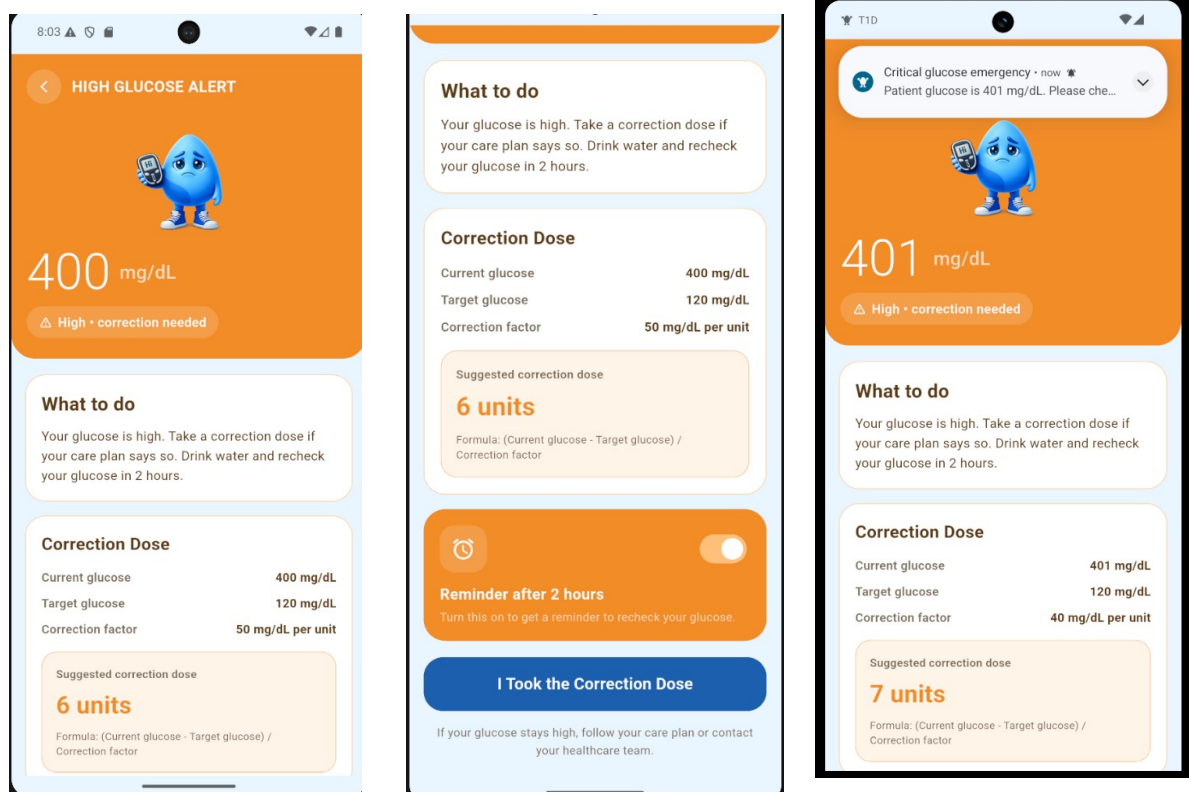
$$\frac{260 - 120}{50} = 2.8$$

The application rounds the calculated dose to the nearest whole number before displaying it to the patient. In this example, the suggested correction becomes about 3 units.

If the correction factor is missing or invalid, the application does not calculate a dose and displays a placeholder instead. This is important because the application should not suggest an insulin correction without the required patient-specific parameter.

The High Glucose screen also includes a reminder option. If the patient confirms the correction and keeps the reminder enabled, the application schedules a high glucose follow-up reminder. This reminder asks the patient to recheck glucose after two hours. The follow-up notification is specific to the high glucose case and helps the patient remember to check whether the glucose level improved.

The screen also reminds the patient that if glucose stays high, they should follow their care plan or contact their healthcare team. This keeps the feature supportive and safe, especially because insulin decisions depend on the patient's medical plan.



(a). High glucose alert screen (b). Correction dose suggestion (c). High glucose follow-up reminder

Figure 3.12: High Glucose Handling and Correction Support

Glucose Reports

The Reports page provides a deeper analysis of glucose readings. While the home page focuses on the current day and the latest reading, the Reports page summarizes glucose data over longer periods. The patient can view weekly, monthly, and yearly reports.

When the report page loads, it retrieves all glucose readings from the backend. The readings are sorted by time and cleaned before analysis. Similar to the home chart, duplicated readings

in the same second are removed, and suspicious jumps are ignored. This improves the quality of the report because the statistics are calculated using cleaner data.

The report can be displayed for different periods. In the weekly report, the system uses the last seven days. In the monthly report, it uses the current month. In the yearly report, it uses the current year. For each selected period, the system filters the readings and calculates the required statistics.

The average glucose is calculated by summing all glucose values in the selected period and dividing them by the number of readings:

$$\text{Average Glucose} = \frac{\text{Sum of Glucose Readings}}{\text{Number of Readings}}$$

The report also calculates the minimum and maximum glucose values. These values help the patient understand the lowest and highest readings during the selected period.

The system estimates A1C using the average glucose value. The formula used is:

$$\text{Estimated A1C} = \frac{\text{Average Glucose} + 46.7}{28.7}$$

This value gives the patient a general idea about long-term glucose control. However, it is only an estimate based on entered readings and does not replace laboratory HbA1c testing.

The report also calculates time in range. Each reading is classified into one of three categories: low, in range, or high. Readings below 70 mg/dL are counted as low. Readings above 180 mg/dL are counted as high. Readings between 70 and 180 mg/dL are counted as in range. After counting the readings in each category, the system calculates the percentage for each group:

$$\text{Percentage} = \frac{\text{Category Count}}{\text{Total Readings}} \times 100$$

For example, if the selected period has 20 readings and 14 of them are in range, the in-range percentage is:

$$\frac{14}{20} \times 100 = 70$$

The report also counts low and high episodes. An episode means a continuous group of readings in the same abnormal category. For example, if the patient has several high readings one after another, they are counted as one high episode until the glucose returns to another category. This is better than simply counting every high reading separately because it gives a clearer picture of repeated glucose events.

The chart inside the report depends on the selected period. In the weekly report, the system calculates the average glucose for each day. In the monthly report, it calculates the average glucose for each week of the month. In the yearly report, it calculates the average glucose for each month. These points are then displayed in a chart to help the patient understand glucose patterns visually.

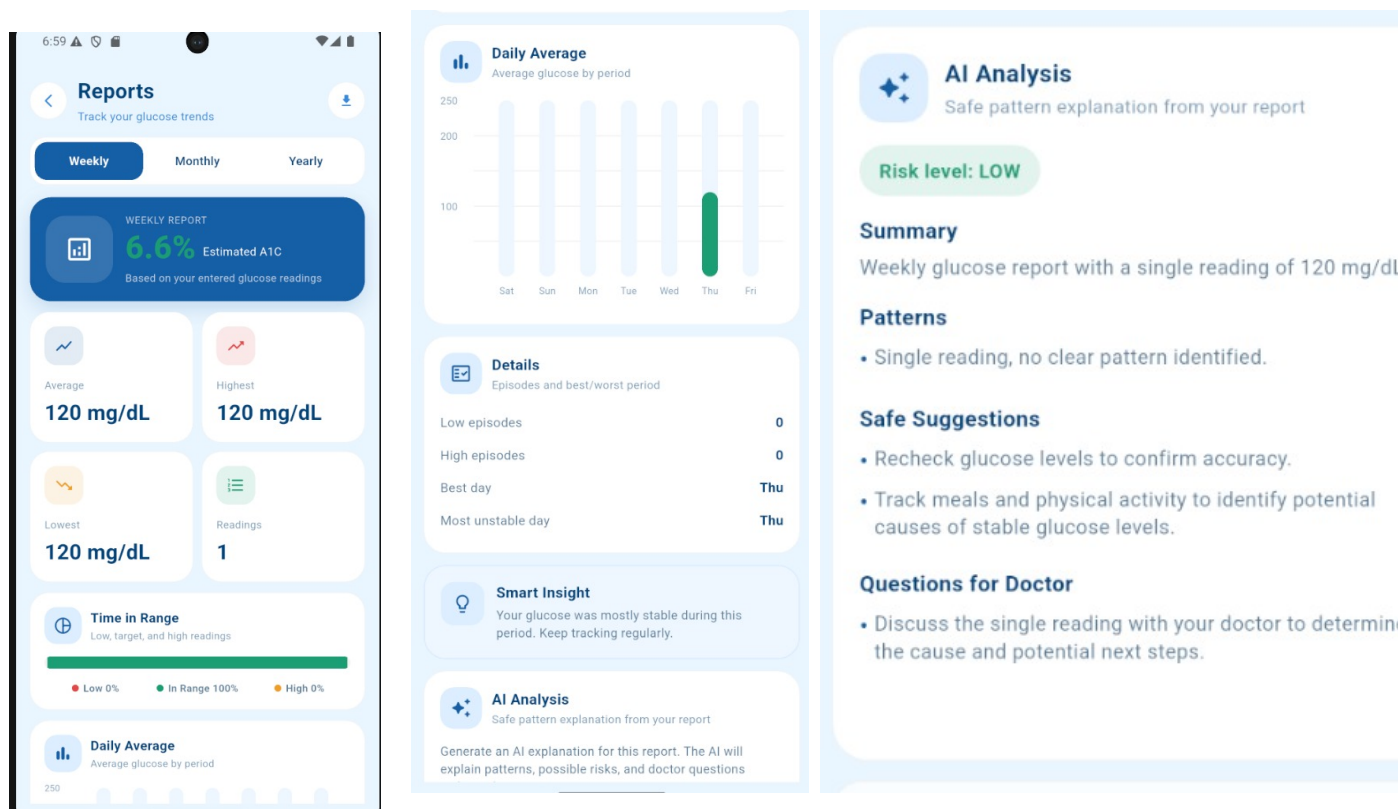
The report also identifies the best and worst periods. The best period is the one whose average

glucose is closest to the target value of 120 mg/dL. The worst period is the one whose average glucose is farthest from 120 mg/dL. This helps the patient and healthcare provider identify when glucose control was better or worse.

In addition to statistics, the report provides a smart insight. The insight is generated based on the percentage of low readings, high readings, in-range readings, and the number of low or high episodes. For example, if low episodes are repeated, the report recommends reviewing the pattern with the doctor. If high readings are frequent, it suggests reviewing meal timing, carbohydrate intake, or insulin timing.

The report can also send the calculated summary to an AI analysis service. The payload includes the period, number of readings, average glucose, estimated A1C, minimum and maximum glucose values, time-in-range percentages, low and high episodes, best period, most unstable period, chart data, and a safety instruction. The safety instruction tells the AI not to prescribe insulin doses or treatment changes, but only to explain patterns and recommend contacting a doctor when needed.

Finally, the report supports exporting the glucose report as a PDF file. The generated PDF includes the report header, selected period, summary statistics, estimated A1C, time in range, chart data, details, smart insight, and AI analysis if available. This allows the patient to share a clear report with their doctor or keep it for follow-up.



(a). Glucose report overview

(b). Report statistics and time
in range

(c). Report insight and export
options

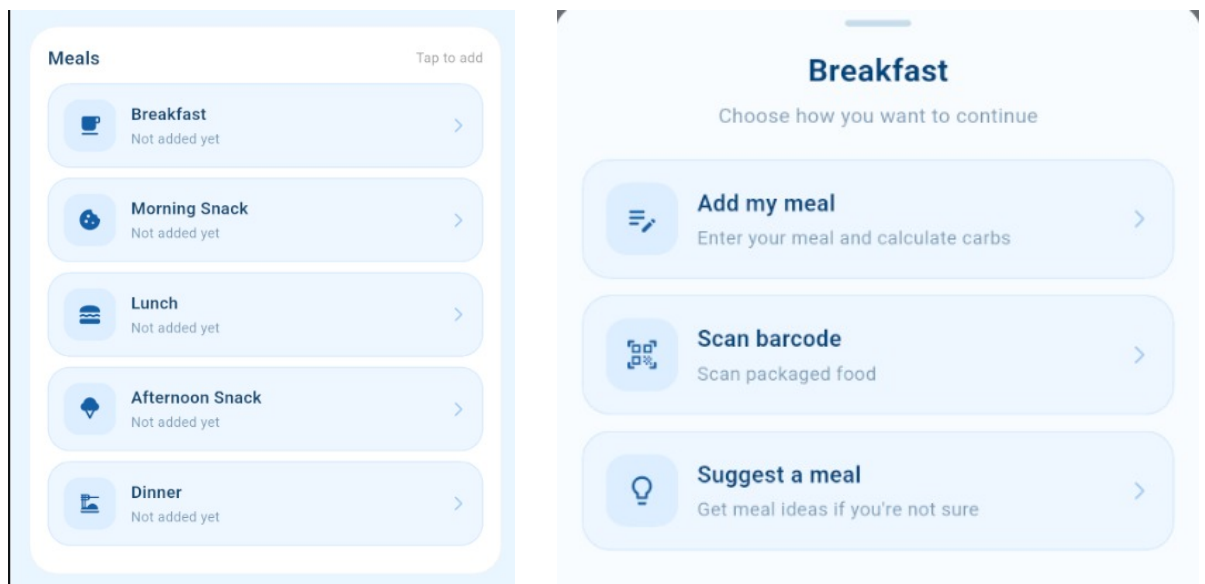
Figure 3.13: Glucose Reports and Analysis

Meal Logging

The Meal Logging feature allows the patient to record daily meals in an organized way. This feature is important for Type 1 Diabetes management because food intake, especially carbohydrates, has a direct effect on glucose levels. For this reason, the T1D application provides more than one way to add food information.

From the patient home page, the meals section shows the main daily meals such as breakfast, morning snack, lunch, afternoon snack, and dinner. Each meal initially appears as not added yet. When the patient taps on a meal, the system opens a bottom sheet that allows the patient to choose how they want to continue. The patient can add a meal manually, scan a packaged food barcode, or ask the system to suggest a meal.

This design makes the feature flexible. If the patient already knows what they ate, they can enter the meal manually. If the food is packaged, they can scan the barcode. If the patient is not sure what to eat, they can use the meal suggestion feature.



(a). Meals section

(b). Choose meal action

Figure 3.14: Meal Logging Options in the Patient Side

Manual Meal Entry

The Add My Meal feature allows the patient to add a meal in a detailed way. The patient can enter the meal name and add each ingredient separately, with the specific quantity for each ingredient. This makes the meal entry more accurate because the application does not treat the meal as one general item, but analyzes its components based on the entered quantities.

After adding the ingredients and their quantities, the patient presses the **Calculate** button. The application then calculates the nutritional values of the meal, such as carbohydrates, calories, protein, and fat. Based on the total carbohydrates and the patient's carb ratio stored in the profile, the application also calculates the suggested insulin units for the meal.

In this feature, the patient does not need to enter the insulin dose manually or calculate it by themselves. The application performs the calculation automatically based on the entered meal data and the patient's medical profile. This helps reduce calculation errors and makes meal logging easier and faster.

If the patient wants to repeat the same meal later, they do not need to enter all the details again. The application provides a **Saved Meals** option, where the patient can choose a previously saved meal and reuse it directly. This makes logging repeated meals faster, especially for daily meals or meals that the patient eats regularly.

(a). Add meal form

(b). Nutrition fields

(c). Meal details

(d). Saved meal

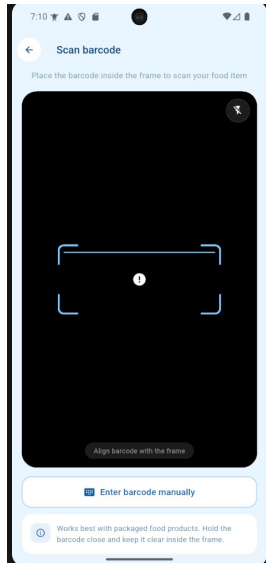
Figure 3.15: Manual Meal Entry Screens

Barcode Scanning for Packaged Food

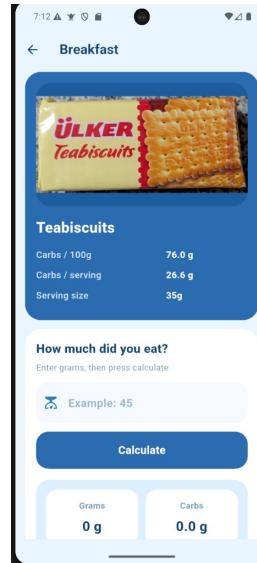
The barcode scanning feature was added to make food logging easier for packaged products. Instead of entering all nutrition values manually, the patient can scan the barcode of the food package. After scanning, the application searches for the product information using the barcode. The application uses the OpenFoodFacts service to retrieve the product data. If the product is found, the system opens the product result screen and displays the available nutrition information. If the product is not found, the application shows a message telling the patient that the product was not found.

This feature reduces manual typing and helps the patient enter more accurate nutrition values when the food is available in the product database. It is especially useful for snacks, drinks, and packaged meals.

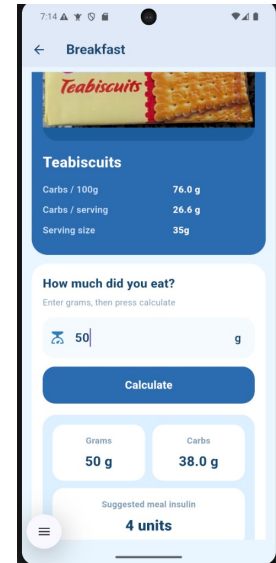
The system also loads the patient profile before opening the product result screen. If the patient has a carb ratio saved in the profile, the carb ratio is passed to the product result screen. This allows the food information to be connected with the patient's diabetes management data, especially when carbohydrate counting is used.



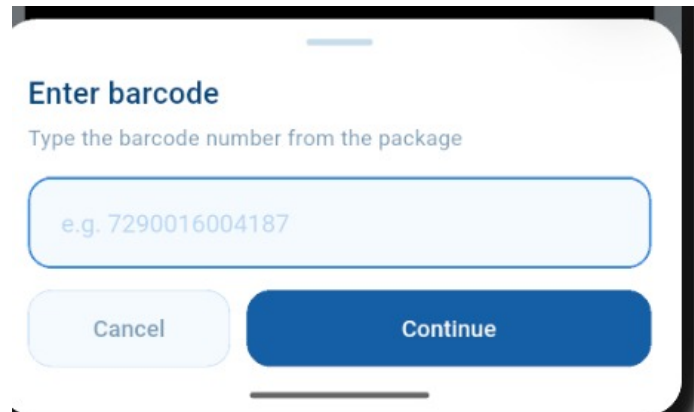
(a). Start barcode scan



(b). Product information



(c). Add scanned food



(d). Enter barcode manually

Figure 3.16: Barcode Scanning for Packaged Food

Meal Suggestion

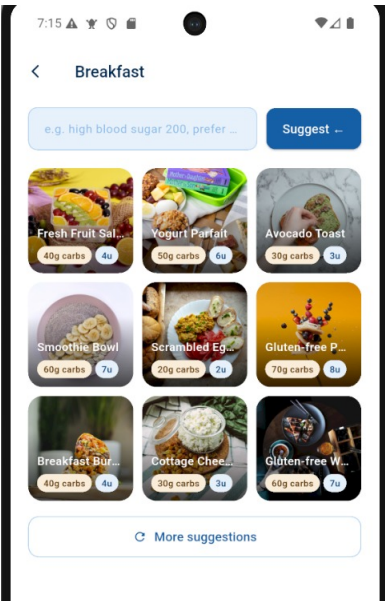
The meal suggestion feature helps the patient when they are not sure what to eat. Instead of forcing the patient to manually choose a meal, the application provides suggested meal ideas based on the selected meal type.

When the patient selects the Suggest Meal option, the application opens the meal suggestion screen and sends the selected meal type and patient ID. The meal type is important because breakfast suggestions should be different from lunch, dinner, or snacks. The patient ID is also needed because the system can use patient-related information when generating or saving suggestions.

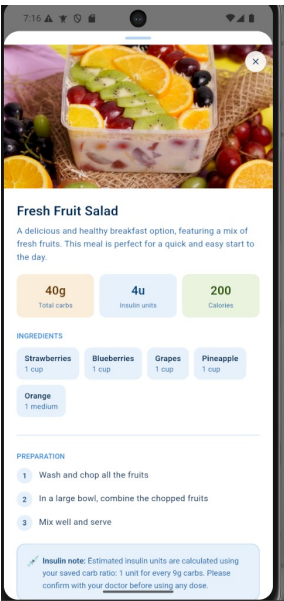
The purpose of this feature is to support the patient in choosing meals that are easier to track and more suitable for diabetes follow-up. The suggested meals can help the patient think about food choices without leaving the application or searching manually.

The suggestion screen allows the patient to view suggested meal options and select a suitable

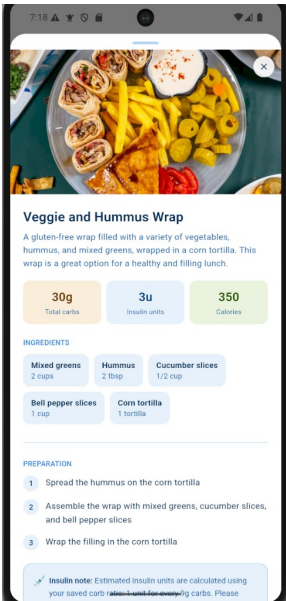
one. After selecting a suggestion, the patient can use it as a starting point for logging the meal. This makes meal logging faster and more helpful, especially for patients who do not always know what to enter.



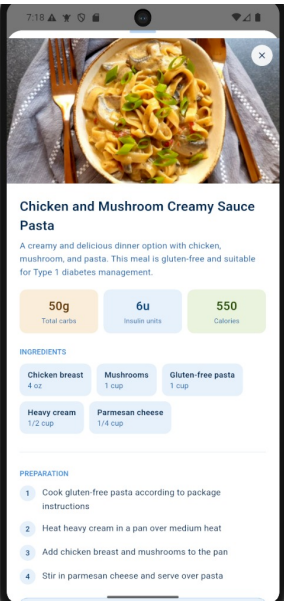
(a). Open meal suggestion



(b). Suggested meals



(c). Meal suggestion details



(d). Use suggested meal

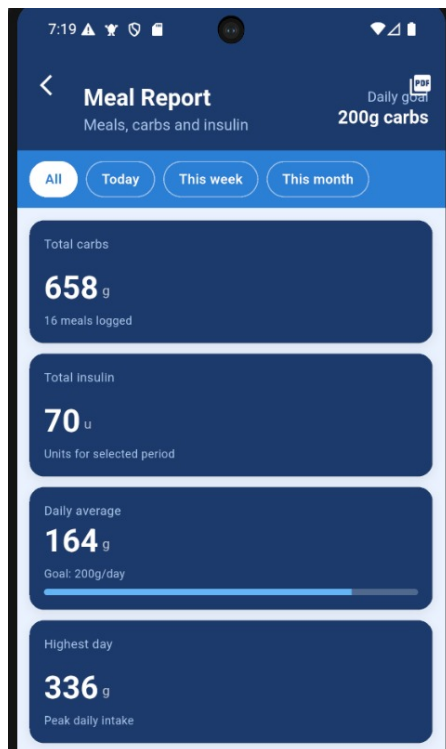
Figure 3.17: Meal Suggestion Feature

Meals Report

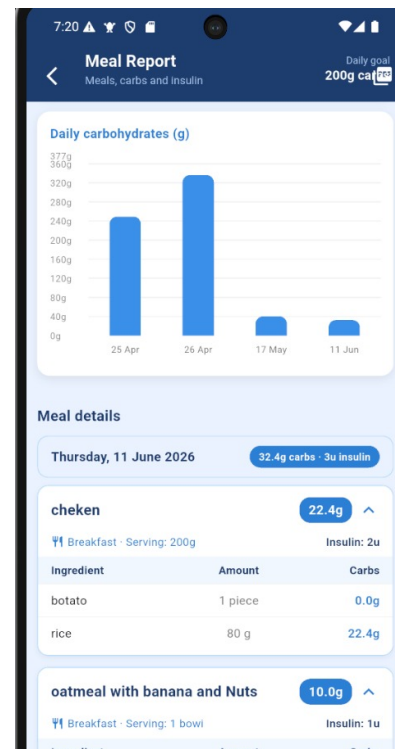
The Meals Report page summarizes the meals that were logged by the patient. This page helps the patient review food intake instead of only seeing meals one by one. It can show logged meals with their nutrition values, such as carbohydrates, calories, protein, and fat.

The report is useful because it connects daily food tracking with diabetes follow-up. By reviewing meals, the patient can notice patterns such as meals with higher carbohydrates or days with missing meal logs. This can help the patient become more aware of food habits and prepare better information for the doctor or nutritionist.

The meal report also supports the family and nutrition follow-up indirectly. Since meal data is stored in the system, other related features can use it to show meal summaries, last logged meal, and daily meal status. This makes food tracking part of the full diabetes care flow inside T1D.



(a). Meals report overview



(b). Meal nutrition details

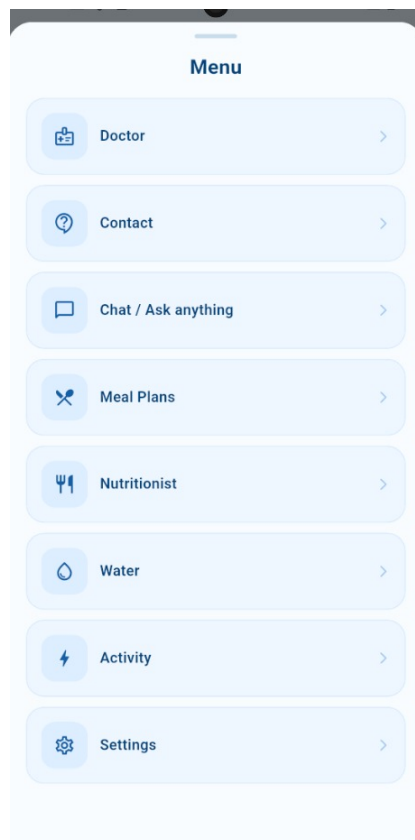
Figure 3.18: Meals Report in the Patient Side

Patient Menu

The Patient Menu provides quick access to the main supporting features in the patient side of the T1D application. Instead of placing all features directly on the home page, the application uses a menu bottom sheet to keep the home page simple and organized.

When the patient taps the Menu option from the bottom navigation bar, a bottom sheet appears from the bottom of the screen. This menu was implemented as a scrollable sheet, which makes it suitable for mobile screens because the user can drag it up or down. The menu contains several options such as Doctor, Contact, Chat, Meal Plans, Nutritionist, Water, Activity, and Settings.

Each menu item has an icon and a label. When the patient taps an item, the application closes the menu and navigates to the selected page. For example, the Activity option opens the activity tracking screen, the Water option opens the water tracker page, the Meal Plans option opens the assigned meal plans page, and the Settings option opens the patient settings screen. This makes the patient side easier to use because important features are grouped in one place. The menu also supports both English and Arabic labels through the shared translation system. The displayed label changes depending on the selected language, while the internal navigation logic still uses the original item name to decide which page should be opened.



Patient menu bottom sheet

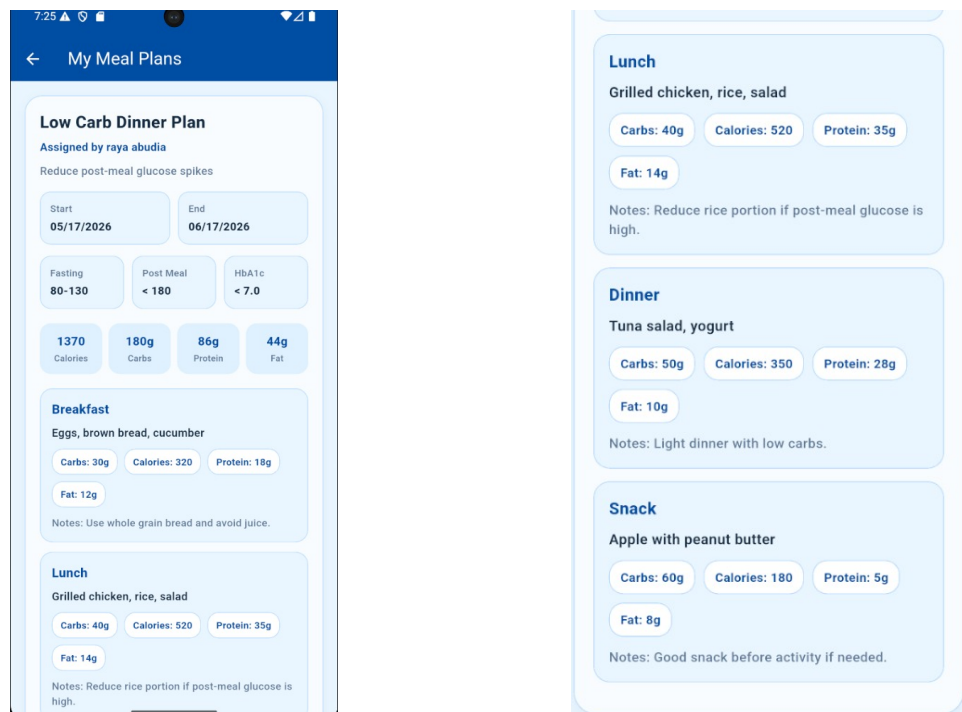
Figure 3.19: Patient Menu in the T1D Application

Assigned Meal Plans

The Meal Plans option allows the patient to view meal plans assigned by the nutritionist. This feature connects the patient side with the nutritionist side of the system. After the nutritionist creates a meal plan for a patient, the patient can open the Meal Plans page from the menu and review the assigned plan.

The meal plan page helps the patient follow nutrition instructions in a clear way. It can show the plan title, goal, dates, meals, nutrition values, and notes. This is useful because the patient does not need to receive the plan outside the application or depend on messages only. The plan becomes part of the patient's daily follow-up system.

This feature is important for Type 1 Diabetes management because meals and carbohydrate intake affect glucose levels. By viewing the nutritionist's assigned plan inside the application, the patient can better organize meals and follow a more structured routine.



(a). Assigned meal plans list

(b). Meal plan details

Figure 3.20: Assigned Meal Plans for the Patient

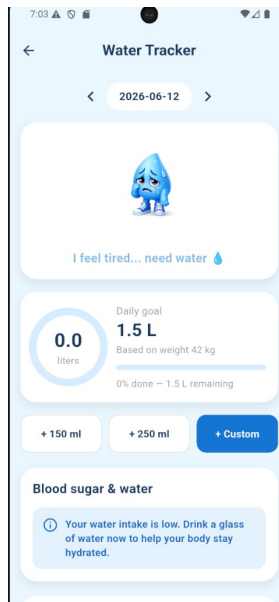
Water Tracker

The Water Tracker feature helps the patient record daily water intake. This feature was added because hydration is part of general health follow-up and can support the patient in building a healthier daily routine.

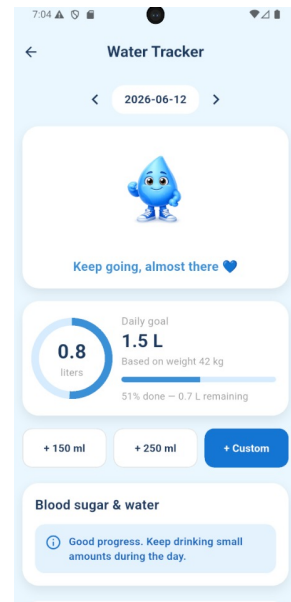
From the menu, the patient can open the Water page. The page displays the daily water tracking interface and allows the patient to add water amounts during the day. Each added amount updates the daily progress, so the patient can see how much water was consumed.

The water tracker is designed to be simple. The patient does not need to enter complicated information. They can add water intake using quick actions, and the system updates the total value. This makes the feature easy to use during the day.

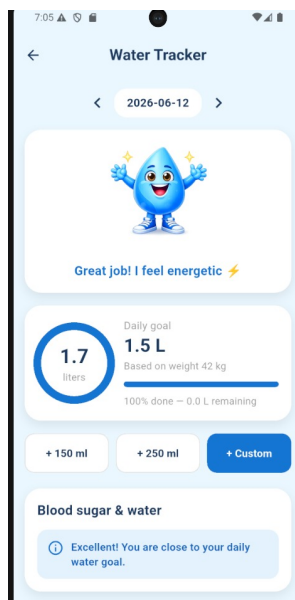
The main goal of this feature is not to calculate insulin or glucose directly, but to improve daily self-care tracking. Since the application already tracks glucose, meals, activity, and reports, adding water tracking makes the patient follow-up more complete.



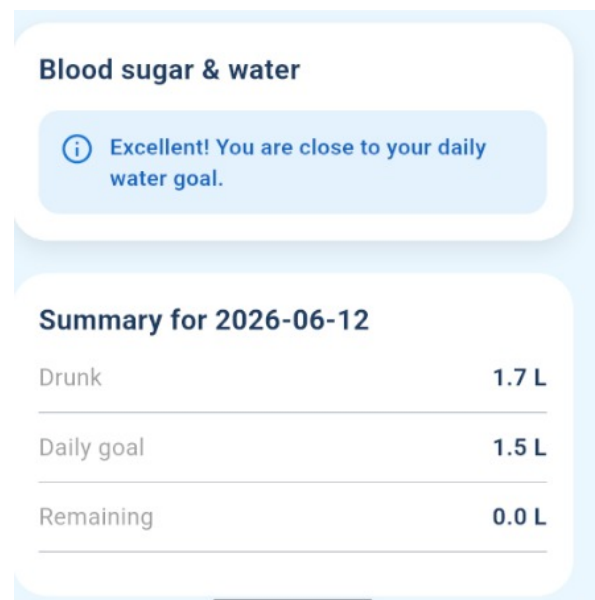
(a). Water tracker page



(b). Add water amount



(c). Updated water progress



(d). Daily water summary

Figure 3.21: Water Tracking Feature

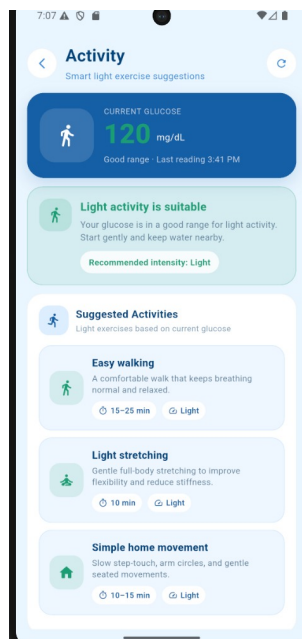
Activity Tracking

The Activity option opens the patient's physical activity page. This feature does not depend on the patient manually entering activities. Instead, it displays suitable activity suggestions based on the patient's latest recorded glucose reading. This helps the patient choose an activity that is more appropriate for their current condition in an easier and safer way.

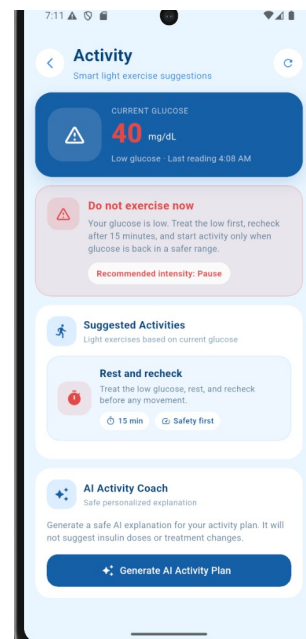
This feature is important in Type 1 Diabetes management because physical activity can affect blood glucose levels. Therefore, the application considers the latest glucose reading when providing suggestions, so the patient receives general guidance that helps them understand what type of activity may be suitable at that time.

The activity page supports the overall purpose of the application because diabetes management does not depend only on glucose readings. It also includes meals, water intake, physical activity, and reports. By connecting activity suggestions with glucose readings, the patient's daily follow-up becomes more organized and complete.

The application also includes an AI Coach feature, which acts as an intelligent assistant that provides additional activity-related suggestions and guidance in an interactive way. This feature is used as a supportive tool to encourage better self-care, and it is not a replacement for medical advice or the doctor's instructions.

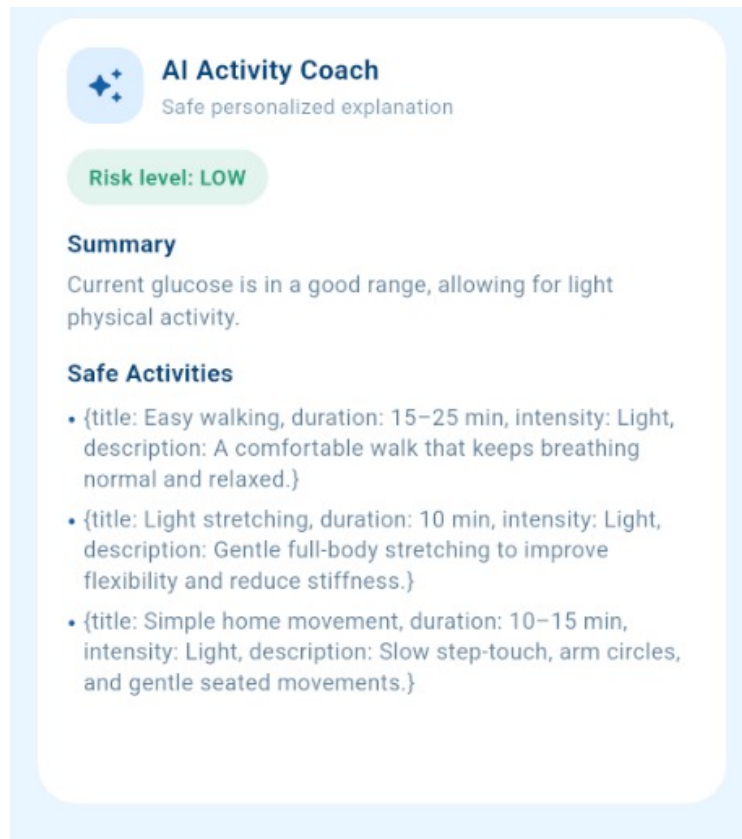


(a). Activity tracking page



(b). Activity in low glucose state

Figure 3.22: Activity Tracking Feature



AI activity support screen

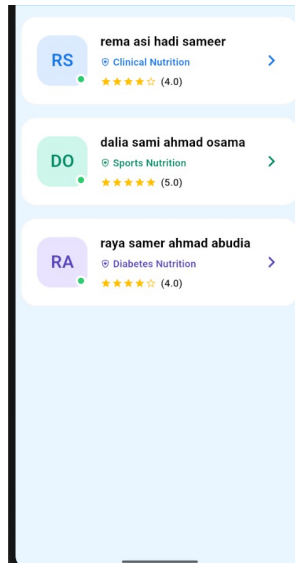
Figure 3.23: AI Support for Activity Tracking

Appointment Booking with Doctors

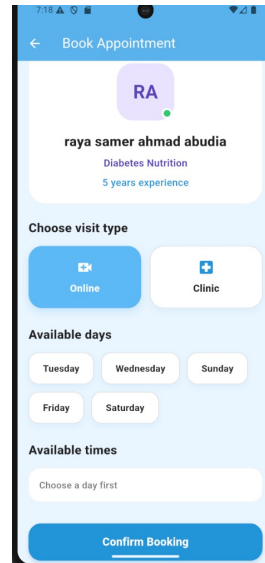
The doctor appointment feature allows the patient to book appointments with approved doctors directly through the T1D application. When the patient opens the doctor appointment page, the system displays the list of approved doctors only. Each doctor card shows important information such as the doctor's name, specialty, workplace, and availability. This approval step is important because doctors must be accepted by the administrator before they appear to patients.

After selecting a doctor, the patient can view the available appointment slots for that doctor. The system displays only the available slots, while booked slots are hidden or disabled. This prevents two patients from booking the same appointment at the same time and keeps the booking process organized.

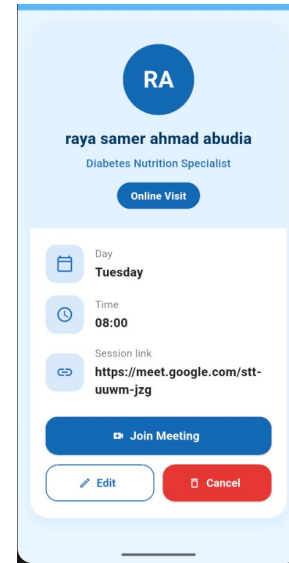
The application supports two types of doctor appointments: online appointments and clinic appointments. In the online appointment flow, the patient selects the doctor, chooses the online visit type, selects an available time, and confirms the booking. After the booking is completed, the appointment appears as a booked online appointment, and the patient can use the meeting link to attend the session remotely.



(a). Approved doctors list



(b). Online appointment slots

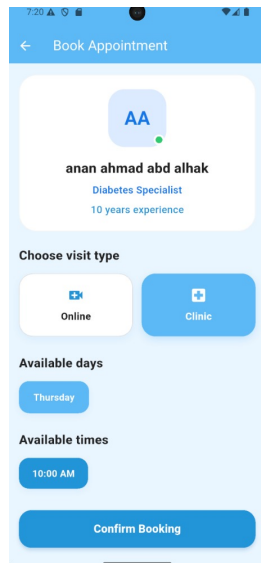


(c). Booked online appointment

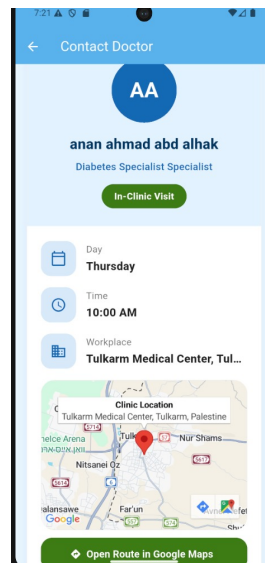
Figure 3.24: Online Doctor Appointment Booking Steps

For clinic appointments, the patient chooses the clinic visit type instead of the online visit type. After selecting the day and time, the appointment is saved as a face-to-face clinic appointment. In this case, the application uses the doctor's workplace address to provide clinic location support.

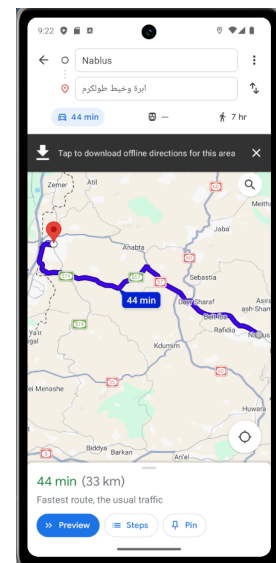
The clinic appointment flow includes a map feature. The patient can open the clinic location on the map and then open route directions using Google Maps. This helps the patient reach the clinic more easily because the map can show the shortest available route from the patient's location to the clinic.



(d). Clinic appointment booking



(e). Clinic location



(f). Shortest route directions

Figure 3.25: Clinic Doctor Appointment with Location and Route Directions

Chat System and Communication with Specialists

The chat system in the T1D application allows the patient to communicate directly with health-care providers. This feature was added to make follow-up easier and more organized, because patients with Type 1 Diabetes may need to ask questions, discuss glucose readings, follow up after appointments, or communicate about meals and health changes.

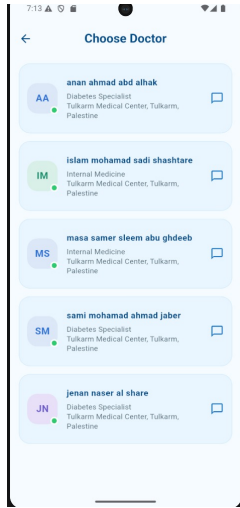
The communication feature supports two main specialist types: doctors and nutritionists. The patient can choose whether they want to contact a doctor or a nutritionist depending on the type of support needed. Medical questions, glucose concerns, and treatment follow-up can be discussed with doctors, while meal planning, food choices, and nutrition-related questions can be discussed with nutritionists.

When the patient opens the contact section, the application displays communication options. The patient can select the provider type and then view the available specialists. The list shows approved doctors and nutritionists only, which helps keep communication safe and organized. After selecting a specialist, the patient can open the chat page and start a conversation.

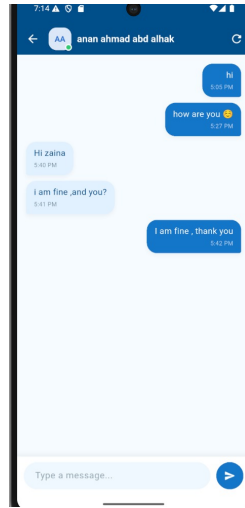
The chat system improves the connection between patients and healthcare providers. Instead of using external messaging applications, the patient can communicate inside T1D, where the communication is connected to the same healthcare follow-up system. This makes the application more complete because glucose tracking, reports, appointments, meal plans, and communication are all available in one place.

The system also supports role-based communication. This means that the patient communicates with doctors or nutritionists based on their roles in the system. Each conversation is connected to the selected specialist, which helps keep messages organized and prevents confusion between different providers.

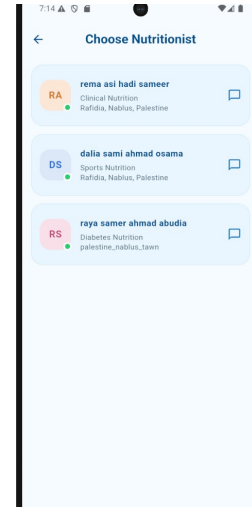
This feature is important because it supports continuous care. The patient does not need to wait until the next appointment to ask about a concern. They can send a message to the doctor or nutritionist and receive follow-up through the application. This makes T1D more useful as a daily diabetes management platform.



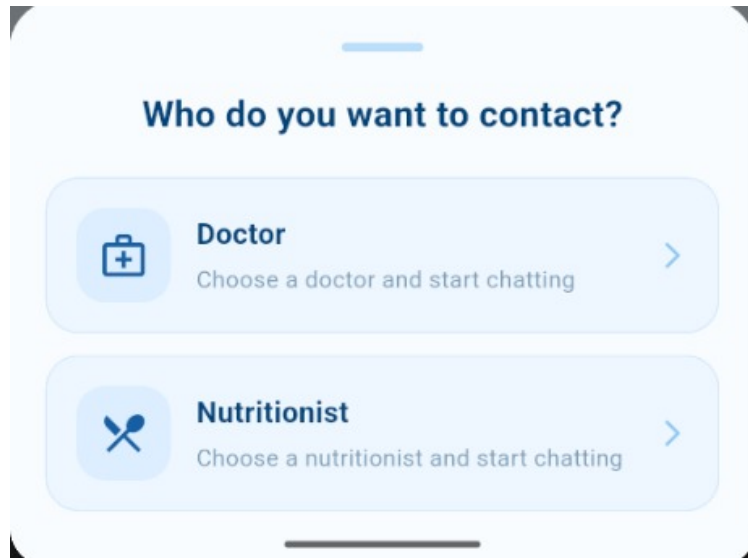
(a). Choose doctor



(b). Chat page



(c). Choose nutritionist



(d). Contact section

Figure 3.26: Patient Communication with Doctors and Nutritionists

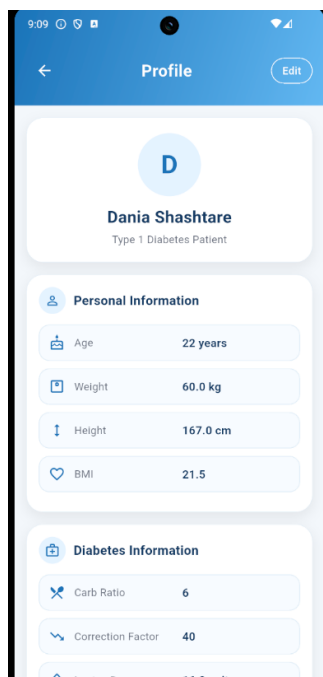
Patient Profile and Lantus Reminder

The patient profile is an important part of the T1D application because it stores the patient's personal and medical information in one place. This information is not only displayed to the user, but it is also used by other features inside the application.

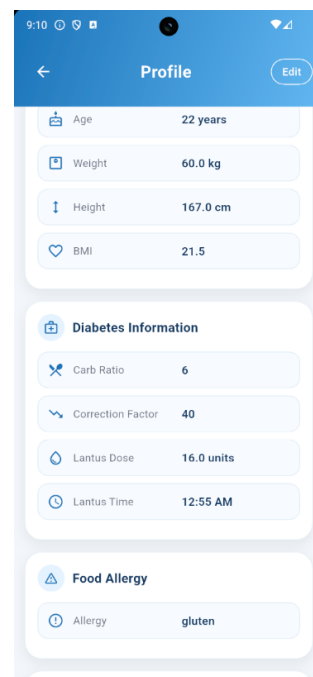
The profile includes basic patient information such as name, age, height, weight, and diabetes-related details. It also includes important medical parameters such as diabetes management method, carb ratio, correction factor, Lantus dose, and Lantus time. These values help the application provide a more personalized experience for the patient.

For example, the carb ratio can be used when calculating carbohydrates for meals, while the correction factor can be used when the patient has high glucose and the application needs to show a suggested correction value. The Lantus time is also very important because it is used to schedule reminders for the daily Lantus dose.

The profile page allows the patient to review their information and update it when needed. This is important because diabetes management values may change over time, such as weight, insulin doses, carb ratio, correction factor, or Lantus time. Keeping the profile updated helps the rest of the application work more accurately.



(a). Patient profile information



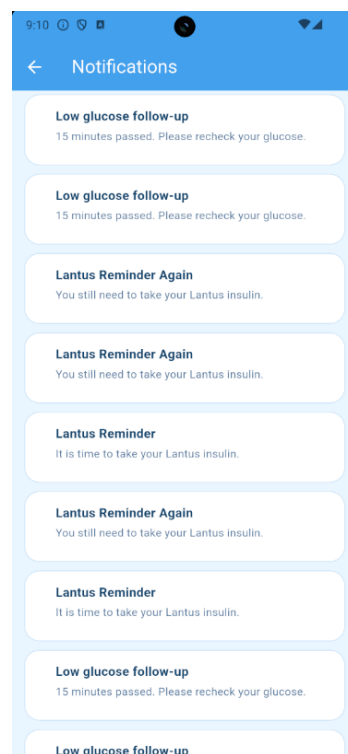
(b). Medical profile details

Figure 3.27: Patient Profile Screens

The Lantus reminder is one of the most important notification features in the patient side. Lantus is usually taken as a daily basal insulin dose, so forgetting it may affect glucose stability during the day or night. For this reason, the application uses the Lantus time stored in the patient profile to remind the patient when it is time to take the dose.

When the reminder time comes, the application sends a Lantus notification to the patient. This helps the patient follow their daily insulin routine and reduces the chance of missing the dose. The notification is connected to the profile information, so if the patient changes the Lantus time in the profile, the reminder can follow the updated time.

This feature is especially useful for patients who have a fixed daily insulin schedule. It also supports family follow-up because reminders and important alerts help make diabetes care more organized and safer.



Lantus reminder notification

Figure 3.28: Lantus Reminder Notification

3.2.3 Use T1D as a Doctor

The doctor side of the T1D application was designed to help doctors follow up with Type 1 Diabetes patients in an organized and efficient way. After the doctor signs in, the system opens the Doctor Dashboard, which provides access to the main doctor features through a side navigation menu. The doctor can view the dashboard, manage patients, review glucose reports, manage appointments, communicate with patients, and update the doctor profile.

The doctor interface is mainly designed for web and large screens because it contains charts, patient lists, appointments, and detailed medical information. This makes the dashboard easier to read and more suitable for medical follow-up.

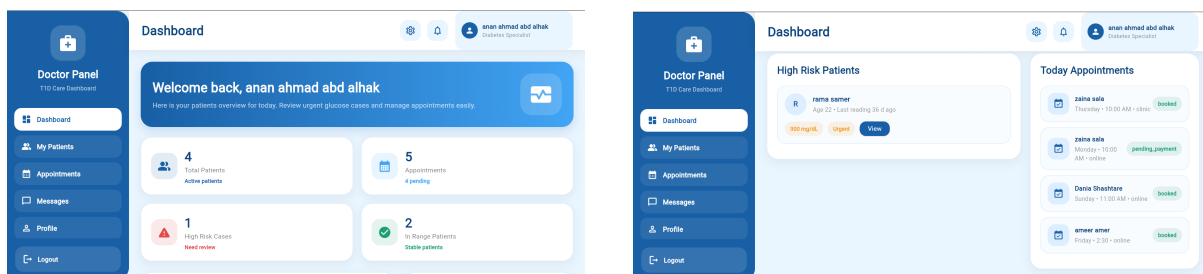
Doctor Dashboard

The Doctor Dashboard is the main page that appears after the doctor logs into the system. It provides a quick overview of the doctor's patients and daily follow-up status. The dashboard includes a welcome card, summary statistics, high-risk patient alerts, and today's appointments. The summary cards show important information such as the total number of patients, the number of appointments, high-risk cases, and patients whose readings are within the normal range. These cards help the doctor quickly understand the general situation without opening each patient profile individually.

The dashboard also includes a High Risk Patients section. This section displays patients who may need urgent review based on their glucose readings or risk status. Each high-risk patient card shows patient information, last glucose reading, risk status, and a View button that allows the doctor to open the patient details page directly.

Another important part of the dashboard is the Today Appointments section. It shows the doctor's appointments with patients, including patient name, appointment day, time, visit type, and appointment status. This helps the doctor manage daily follow-up and avoid missing scheduled appointments.

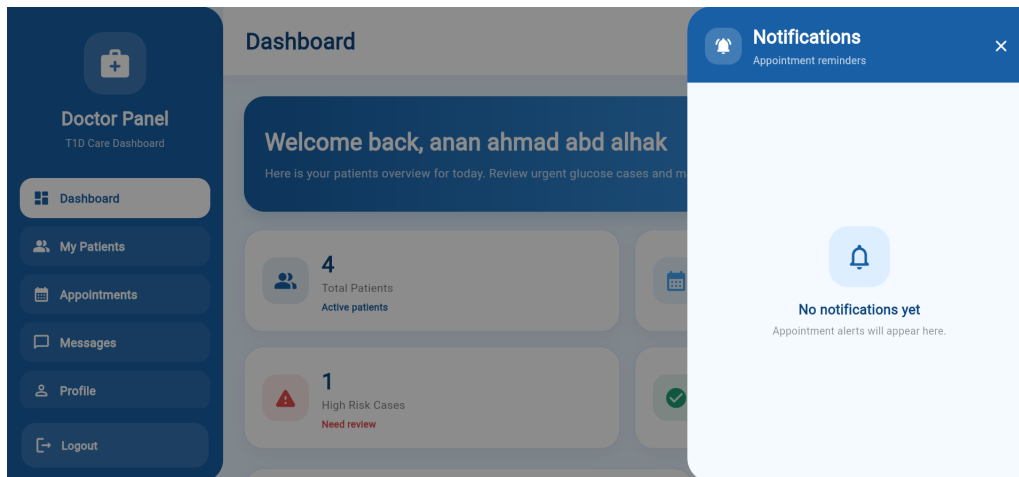
The dashboard also includes appointment reminder notifications. The system checks upcoming appointments and displays reminders before the appointment time and when the appointment starts. This helps doctors stay updated about their schedule.



(a). Doctor dashboard overview

(b). High risk patients and today appointments

Figure 3.29: Doctor Dashboard in the T1D application



Appointment reminder notifications

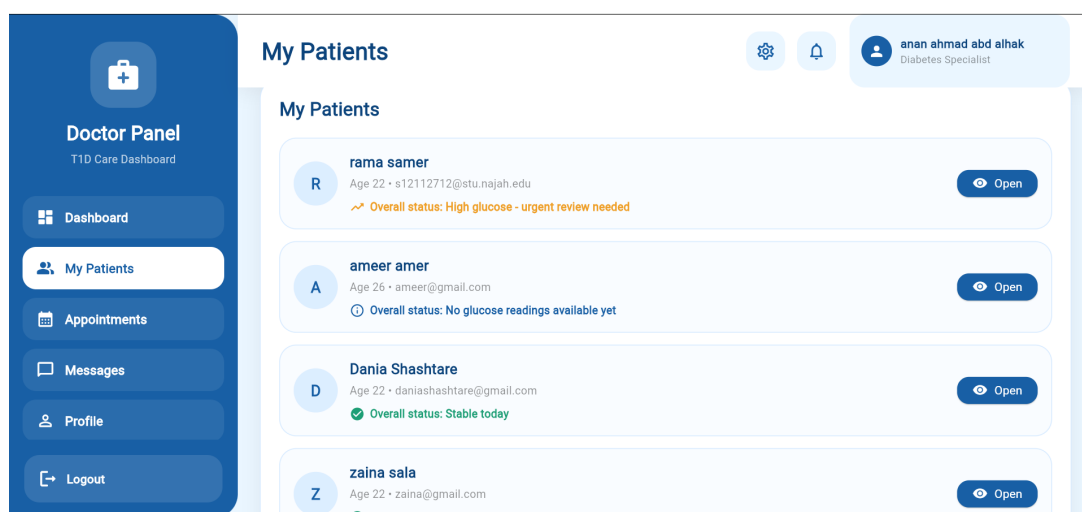
Figure 3.30: Doctor Notifications Panel

Patients Management

The Patients Management page allows the doctor to view all patients connected to their account. Each patient card displays the patient name, email, age, last glucose reading, general glucose status, and risk level. This helps the doctor review all patients from one organized list.

The system classifies the patient's condition based on the latest available glucose information. If the patient has no readings yet, the system shows that no glucose readings are available. If the reading is low or high, the system displays a warning status to indicate that the patient may need medical review. If the reading is stable, the patient is shown as stable.

Each patient card includes an Open button. When the doctor selects a patient, the system loads the patient's details, glucose readings, trend analysis, medical parameters, and report information. This makes the patient list an entry point for detailed follow-up.



My Patients page

Figure 3.31: Patients Management Page for Doctor

Patient Details and Glucose Reports

The Patient Details page allows the doctor to review detailed information about a selected patient. After opening a patient from the Patients Management page or from the High Risk Patients section, the system loads the patient's glucose readings and displays them using a chart. This helps the doctor understand the patient's glucose changes over time.

The glucose chart shows the patient's readings in a visual format. The doctor can use the Date Range filter to display readings for a specific period, such as today, the last 7 days, the last 14 days, the last 30 days, or the current month. This allows the doctor to compare readings across different time periods and identify repeated patterns.

The system also provides a Glucose Trend Prediction section. This section summarizes the trend of the patient's readings and shows whether the patient is improving, stable, or needs attention. This helps the doctor make faster follow-up decisions.

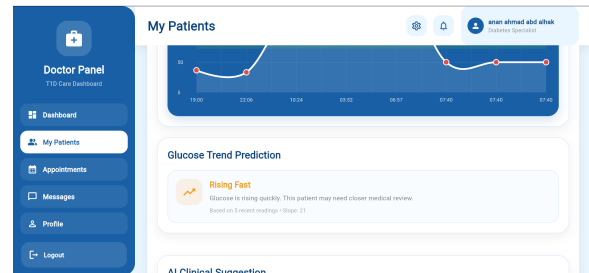
In addition, the Patient Details page includes an AI Clinical Suggestion section. This section gives a general clinical note based on the patient's glucose trend and available data. It is used as a supporting feature to help the doctor review possible concerns, but it does not replace the doctor's medical judgment.

The page also includes a Patient Report section. The report summarizes important glucose-related values such as average glucose, estimated A1C, low events, high events, time in range, and patient risk score. The doctor can also open the full report for a more detailed view.

The patient details area also displays important patient medical parameters such as diabetes management type, carb ratio, correction factor, Lantus dose, Lantus time, weight, height, and food allergy information. The doctor can edit some patient parameters when needed to keep the patient profile updated.

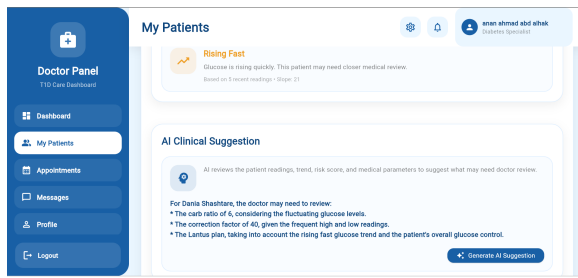


(a). Patient glucose readings chart



(b). Glucose trend prediction

Figure 3.32: Patient Glucose Chart and Trend Prediction

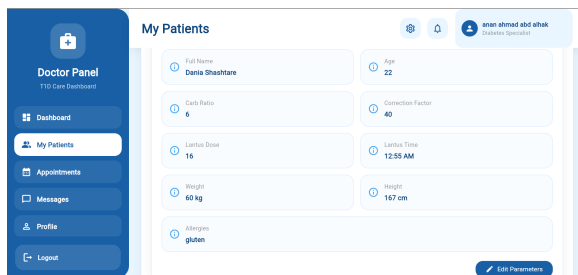


(a). AI clinical suggestion

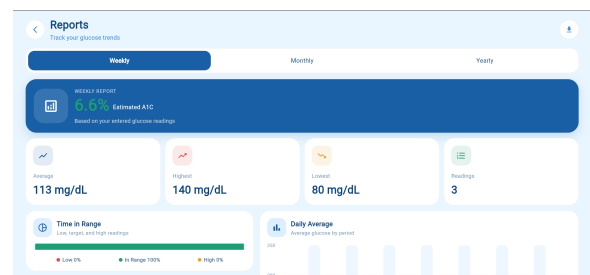


(b). Patient report summary

Figure 3.33: Patient Clinical Analysis and Report Summary



(a). Patient medical parameters



(b). Full patient report page

Figure 3.34: Patient Medical Parameters and Full Report

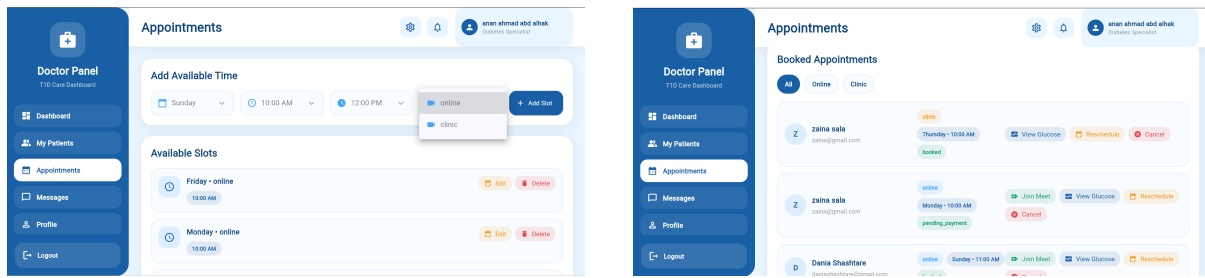
Doctor Appointments

The Doctor Appointments page allows the doctor to manage available appointment slots and booked appointments. The doctor can add available time by selecting the day, start time, end time, and visit type. The visit type can be online or clinic. After adding the available time, it appears in the Available Slots list.

The available slots help patients book appointments based on the doctor's schedule. This makes appointment management more organized and reduces the need for manual communication outside the system.

The page also displays booked appointments. Each appointment card shows the patient name, appointment day, time, visit type, meeting link if available, status, and action buttons. For online appointments, the doctor can open the meeting link directly. The doctor can also view the patient's glucose data, reschedule the appointment, or cancel the appointment.

The appointment page includes filters that allow the doctor to view all appointments, online appointments, or clinic appointments. This makes it easier to manage appointments based on visit type.



(a). Add available appointment time

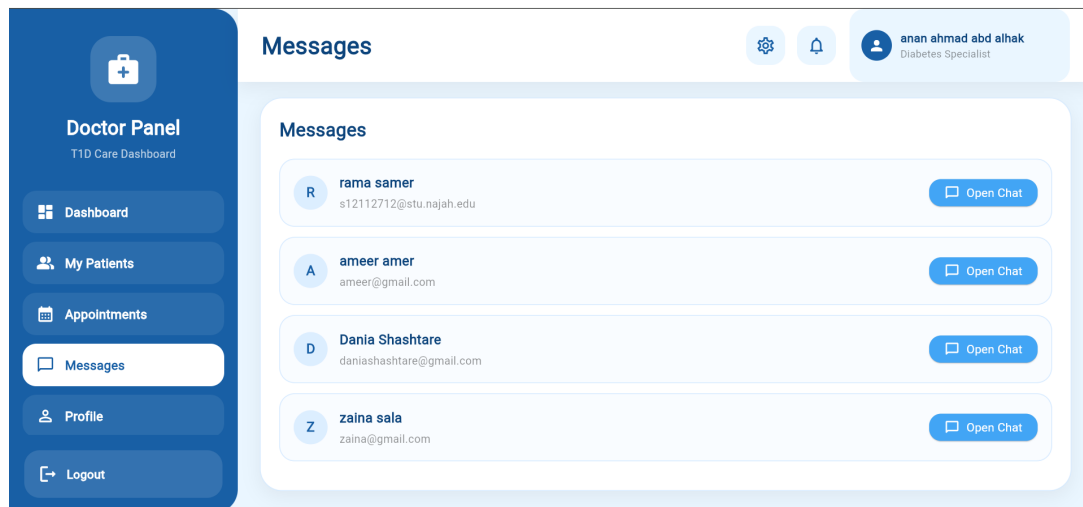
(b). Booked appointments

Figure 3.35: Doctor Appointments Management

Doctor Chat

The Doctor Chat page allows the doctor to communicate with patients through the application. The page displays a list of conversations with patients, and each conversation has an Open Chat button. When the doctor opens a chat, the system navigates to the chat page for direct communication.

This feature helps keep communication between patients and doctors inside the T1D system instead of depending on external messaging applications. It also supports better follow-up because the doctor can communicate with patients based on their glucose data, appointments, and health status.



Doctor messages page

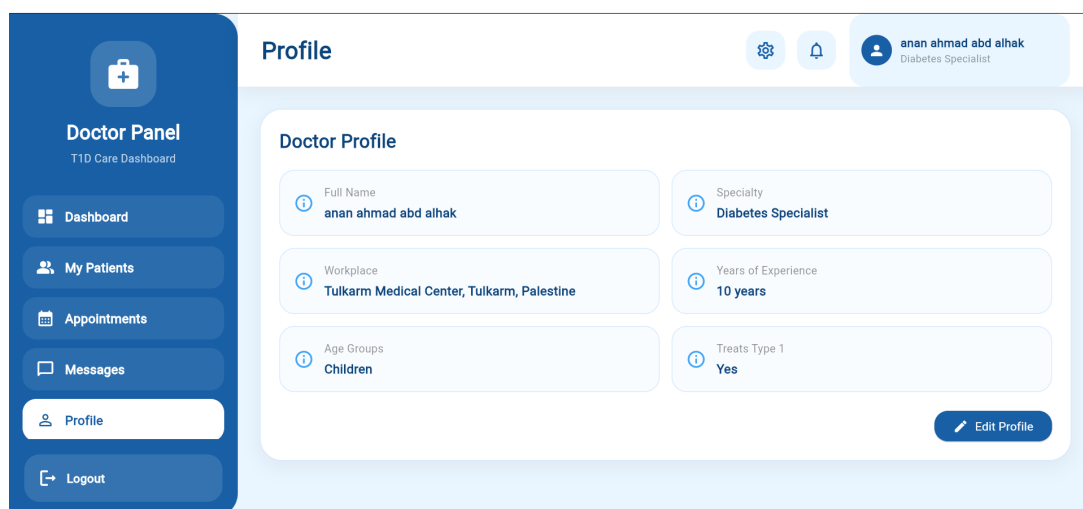
Figure 3.36: Doctor Chat and Communication Page

Doctor Profile Page

The Doctor Profile page displays the doctor's professional information. It shows the doctor's full name, specialty, workplace, years of experience, age groups followed, and whether the doctor treats Type 1 Diabetes patients. This information is important because it helps identify the doctor's professional background and the type of patients they can follow.

The profile page also includes an Edit Profile button. This allows the doctor to update profile information when needed, such as workplace, specialty, experience, supported age groups, and Type 1 Diabetes treatment experience.

The settings icon in the top bar redirects the doctor to the shared settings page. Since the settings page is used by different roles in the system, it is explained later in the Shared System Features section.



Doctor profile page

Figure 3.37: Doctor Profile Page in the T1D application

3.2.4 Use T1D as a Nutritionist

The nutritionist side of the T1D application was designed to support nutritional follow-up for patients with Type 1 Diabetes. After signing in, the nutritionist can access a web dashboard that includes patients, appointments, messages, meal plans, available slots, and profile management. The nutritionist dashboard helps organize the nutrition care process by allowing the nutritionist to review patient information, create meal plans, manage appointments, communicate with patients, and update professional information. The dashboard is designed for large screens because it includes detailed forms, lists, and management sections.

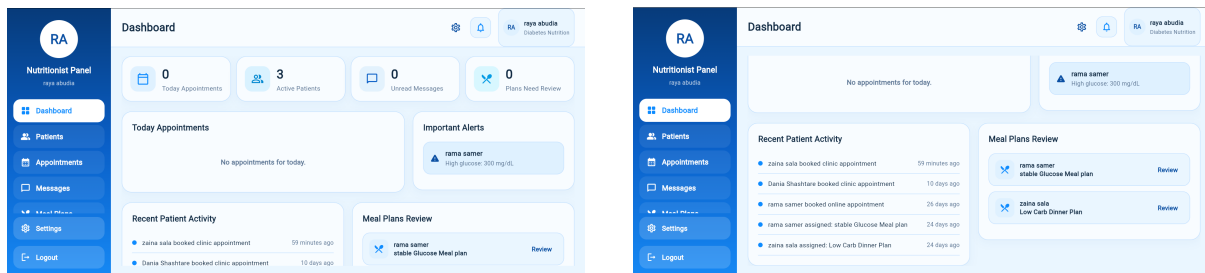
Nutritionist Dashboard

The Nutritionist Dashboard is the main page that appears after the nutritionist logs into the system. It provides a general overview of the nutritionist's daily work and patient follow-up activities.

The dashboard includes summary cards that show important information such as active patients, today's appointments, unread messages, and pending meal plans. These cards help the nutritionist quickly understand the current workload and identify tasks that need attention.

The dashboard also includes sections for today's appointments, patient alerts, recent activities, and meal plans that may need review. This gives the nutritionist a clear overview of patient activity and makes daily follow-up more organized.

The nutritionist dashboard also supports appointment reminder notifications. The system checks appointment times and shows reminders before an appointment starts and when it is time for the appointment. This helps the nutritionist avoid missing scheduled sessions with patients.



(a). Nutritionist dashboard overview

(b). Dashboard statistics and follow-up sections

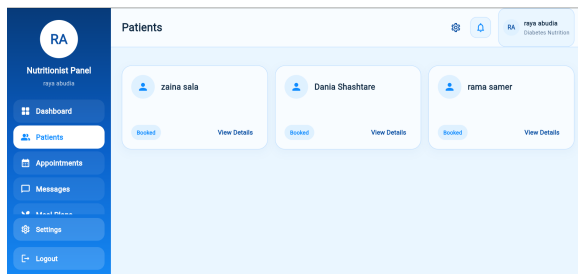
Figure 3.38: Nutritionist Dashboard in the T1D application

Patient Follow-up

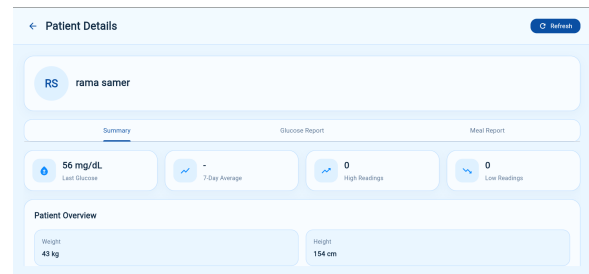
The Patient Follow-up page allows the nutritionist to view patients who are connected through booked appointments. The system displays patient information in an organized list, including patient name and basic details. This helps the nutritionist identify the patients who need nutritional follow-up.

When the nutritionist opens a patient profile, the system displays more detailed patient information. This can include patient data related to diabetes management and nutrition follow-up, such as glucose-related information, patient profile data, and other details that help the nutritionist understand the patient's needs.

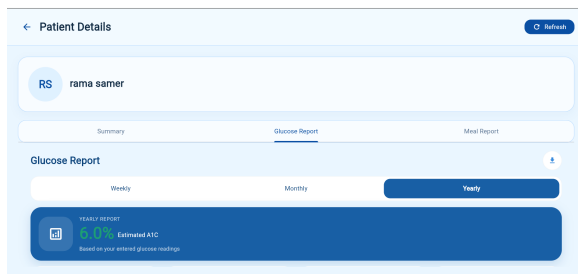
This page is important because meal plans should not be created randomly. The nutritionist needs to understand the patient's condition before preparing a suitable meal plan. Therefore, the patient follow-up page acts as a connection between patient monitoring and meal plan management.



(a). Nutritionist patients page



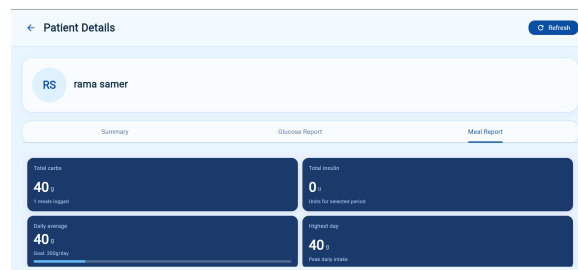
(b). Patient follow-up details



(c). Patient health and nutrition information



(d). Patient follow-up data



(e). Additional patient details

Figure 3.39: Nutritionist Patient Follow-up Pages

Meal Plans Management

The Meal Plans Management page is one of the main features of the nutritionist role. It allows the nutritionist to create structured meal plans for patients with Type 1 Diabetes. The nutritionist selects the patient, enters the plan title, clinical goal, start date, and end date, then defines glucose targets and meal details.

The meal plan form includes glucose target fields such as fasting target, post-meal target, and HbA1c target. These fields help connect the meal plan with diabetes management goals.

The nutritionist can enter meals for breakfast, lunch, and snacks. For each meal, the form allows the nutritionist to enter food items, calories, carbohydrates, protein, fat, and notes. This structure makes the meal plan more complete and useful for the patient.

The system also calculates daily totals, including total calories, carbohydrates, protein, and fat. This helps the nutritionist review the nutritional balance of the plan before saving it.

The page also displays saved meal plans. Existing meal plans can be reviewed and edited when needed. This supports continuous nutritional follow-up instead of creating a plan only once.

The figure consists of two side-by-side screenshots of a web application interface for a Nutritionist. Both screenshots have a dark blue sidebar on the left with a 'RA' logo and navigation links: 'Nutritionist Panel', 'Messages', 'Meal Plans', 'Available Slots', 'Profile', 'Settings', and 'Logout'. The top right of the interface shows the user's name 'raya shadia' and role 'Diabetes Nutritionist'.

(a). Create meal plan form: This view is titled 'Meal Plans' and 'Create meal plan'. It includes a 'Patient' dropdown, a 'Plan title' text field (with example text 'e.g. Low-carb dinner'), a 'Clinical goal' text field (with example text 'e.g. Reduce post-meal spikes, target HbA1c'), 'Start date' and 'End date' date pickers, and 'GLUCOSE TARGETS (MG/DL)' for 'Fasting', 'Post-meal (2h)', and 'HbA1c target (%)'. On the right, it shows '2 Active plans' and '0 Reviews due'. Below this is an 'Assigned plans' section listing two plans: 'fatma samir' (Diabetic Glucose Meal plan, Day 26 of 32) and 'zaina sala' (Low Carb Dinner Plan, Day 26 of 32), each with an 'On track' status and an 'Edit' button.

(b). Meal plan details and saved plans: This view is also titled 'Meal Plans' but shows details for a selected plan. It displays 'Fasting' (80-130), 'Post-meal (2h)' (< 180), and 'HbA1c target (%)' (< 7.0). Below is a 'MEAL BREAKDOWN' section with two entries: 'Breakfast 7:00-9:00 AM' and 'Lunch 12:00-1:30 PM'. Each entry has fields for 'Food items', 'Cal', 'Car...', 'Pro', and 'Fat', and a 'Clinical notes' text area.

(a). Create meal plan form

(b). Meal plan details and saved plans

Figure 3.40: Meal Plans Management for Nutritionist

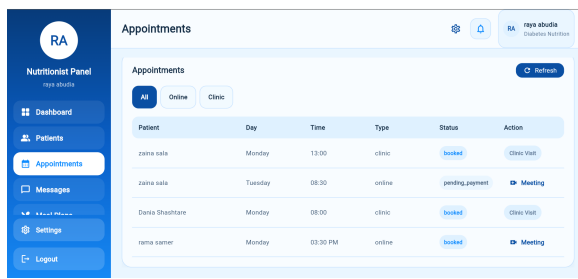
Nutritionist Appointments

The Nutritionist Appointments page allows the nutritionist to manage booked appointments with patients. The page displays appointment information such as patient name, appointment day, time, visit type, meeting link, and status.

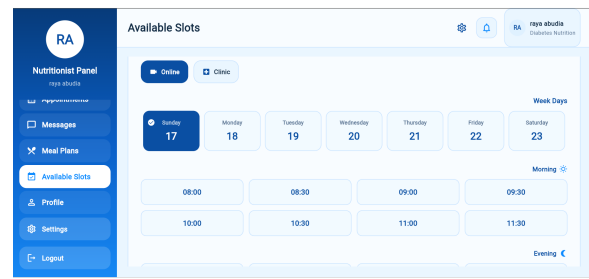
The appointment list can be filtered by visit type, such as all appointments, online appointments, or clinic appointments. For online appointments, the nutritionist can open the meeting link directly from the system. This makes the appointment process easier and keeps the follow-up organized inside the application.

The nutritionist can also manage available slots from the Available Slots page. This page allows the nutritionist to choose the visit type, select days, and choose morning or evening time slots that patients can book. Saved schedules are displayed so the nutritionist can review, edit, or delete available times.

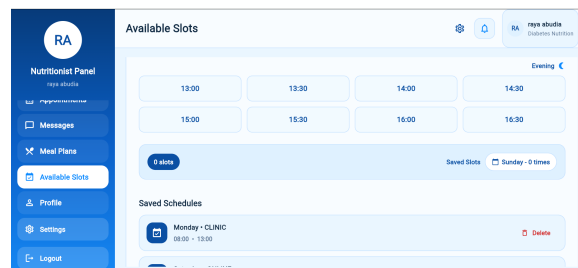
This feature helps reduce manual appointment coordination and allows patients to book appointments based on the nutritionist's real available schedule.



(a). Nutritionist appointments page



(b). Set available slots



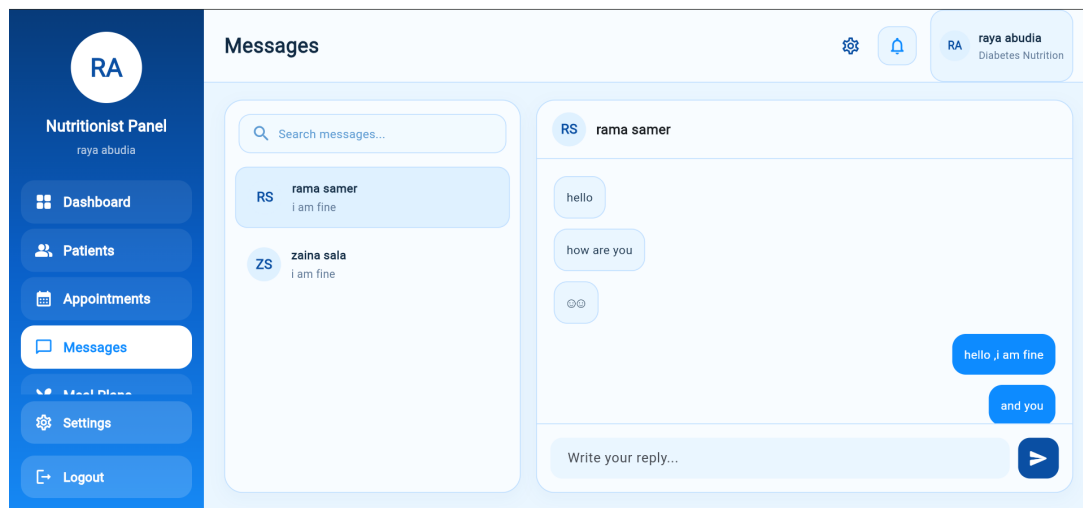
(c). Saved appointment schedules

Figure 3.41: Nutritionist Appointments and Available Slots

Nutritionist Chat

The Nutritionist Chat page allows the nutritionist to communicate with patients directly through the T1D application. The system displays conversations with patients, and the nutritionist can open a conversation, view messages, and send replies.

This feature helps keep nutrition-related communication inside the application instead of using external messaging applications. It also supports better follow-up because the nutritionist can communicate with patients while also having access to meal plans and patient information.



Nutritionist chat and communication page

Figure 3.42: Nutritionist Chat Page

Nutritionist Profile Page

The Nutritionist Profile page displays the professional information of the nutritionist. It includes the nutritionist name, email, phone number, workplace, specialty, and years of experience. This information helps identify the nutritionist and their professional background inside the system. The profile page also provides an edit option that allows the nutritionist to update profile information when needed. The nutritionist can edit fields such as name, phone number, workplace, specialty, and years of experience. After saving, the updated information is stored and displayed in the profile page.

The settings icon redirects the nutritionist to the shared settings page. Since settings are used by different roles in the system, they are explained later in the Shared System Features section.

The screenshot shows the Nutritionist Profile page. On the left is a dark blue sidebar with a 'Nutritionist Panel' header and a list of menu items: Appointments, Messages, Meal Plans, Available Slots, Profile (highlighted), Settings, and Logout. The main content area is titled 'Profile' and features a user card for 'raya abudia' with the specialty 'Diabetes Nutrition'. Below the card are five input fields: Email (rayaabu@gmail.com), Phone (0595594315), Workplace (palestine_nablus_tawn), Experience (5 years), and Specialty (Diabetes Nutrition). An 'Edit Profile' button is located at the bottom left of the main content area. The top right of the page includes a settings gear icon, a notification bell icon, and a user profile summary for 'raya abudia'.

Field	Value
Name	raya abudia
Specialty	Diabetes Nutrition
Email	rayaabu@gmail.com
Phone	0595594315
Workplace	palestine_nablus_tawn
Experience	5 years

Nutritionist profile page

Figure 3.43: Nutritionist Profile Page in the T1D application

3.2.5 Use T1D as a Family Member

The family member side of the T1D application was designed to support patient safety and allow family members to monitor the patient's health status. This role is especially important for patients who need extra support, such as children or patients who may require help during abnormal glucose situations.

After signing in, the family member is linked to a specific patient account. The family home page displays the patient's latest glucose status, last reading time, meals and insulin information, notifications, and a read-only glucose chart. The family member cannot edit the patient's medical data, but can monitor important updates and respond to alerts.

Family Home Page

The Family Home Page provides a quick safety overview of the linked patient. At the top of the page, the family member can access notifications, settings, and the family profile page. The main purpose of this page is to give the family member a clear summary of the patient's current condition.

The page displays the patient's current glucose value, glucose status, and last reading time. The glucose status changes according to the latest reading, such as in range, slightly high, high, low, or no readings yet. This helps the family member quickly understand whether the patient is stable or needs attention.

The family home page also shows important daily follow-up information such as meals, Lantus reminder, last meal logged, and today's glucose chart. These sections help the family member monitor the patient's daily diabetes routine in a read-only way.

Patient Monitoring

The Patient Monitoring feature allows the family member to follow important patient updates without directly using the patient account. The system loads the linked patient's profile, latest glucose readings, meal summary, Lantus reminder, and today's glucose chart.

The monitoring page includes a patient status card that shows the current glucose reading and the last reading time. It also includes a safety card that explains the current situation. If the glucose reading is normal, the system shows that the patient looks okay. If the reading is low or high, the system displays a warning message and suggests that the family member should check on the patient. If no recent glucose reading exists, the system warns that the patient has not checked glucose for a long time.

The Meals and Insulin section shows the number of meals logged today, the scheduled Lantus time, and the last meal logged by the patient. The read-only glucose chart displays today's glucose readings during the day. This allows the family member to understand glucose changes visually, but without editing the patient's data.

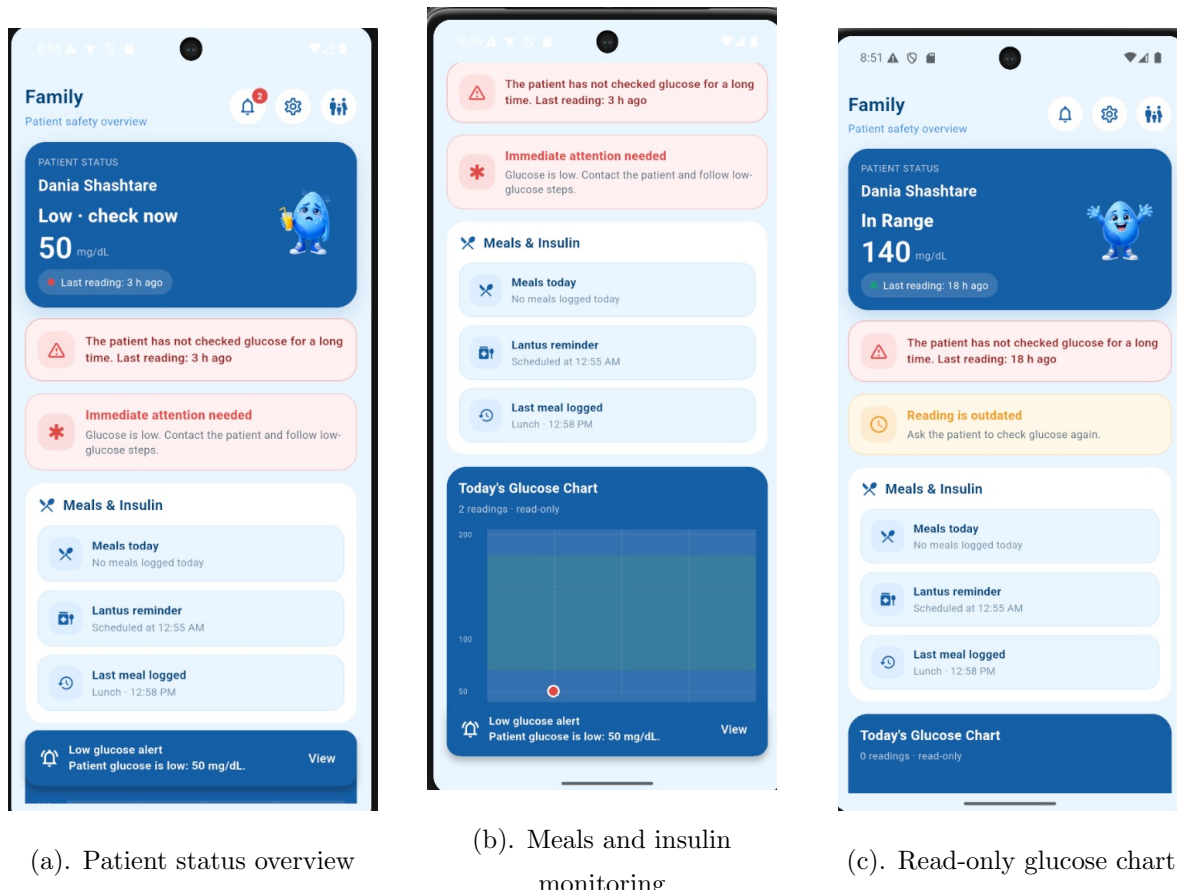


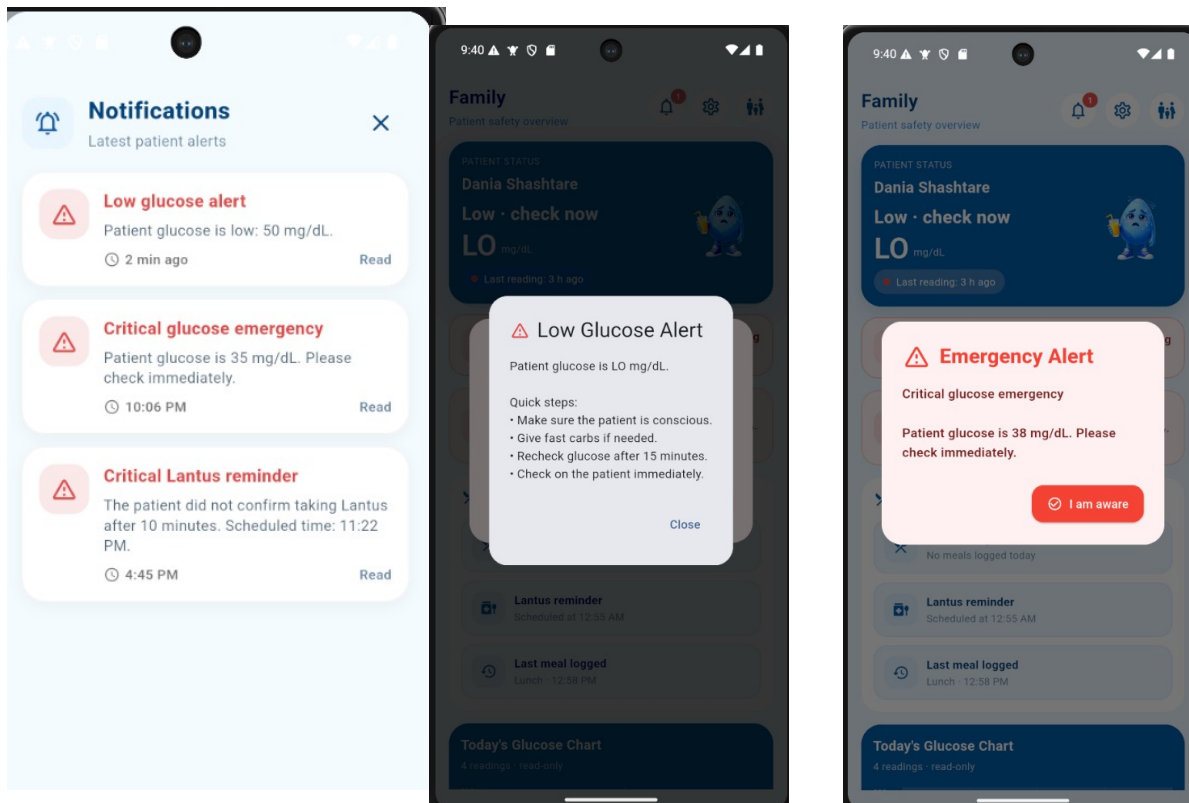
Figure 3.44: Patient Monitoring Features for Family Member

Alerts and Notifications

Alerts and notifications are one of the most important features of the family member role. The system listens for patient notifications using Firebase Firestore. When a new unread notification is received, the family member can open the notifications panel and view the latest patient alerts. The notifications panel displays recent alerts with the notification title, message, time, and read status. The family member can mark notifications as read after checking them. This helps keep alerts organized and ensures that important updates are not missed.

For critical glucose situations, the system displays an emergency alert dialog. For example, if the patient has a very low glucose reading, the application can show a critical warning and play an alarm sound. The family member must press the awareness button to stop the alarm and mark the alert as read. This design helps ensure that urgent glucose alerts receive immediate attention.

The system also provides quick emergency steps in low glucose situations. These steps remind the family member to check if the patient is conscious, give fast carbohydrates if needed, recheck glucose after 15 minutes, and check on the patient immediately.



(a). Notifications icon and alert access

(b). Notifications panel

(c). Emergency glucose alert

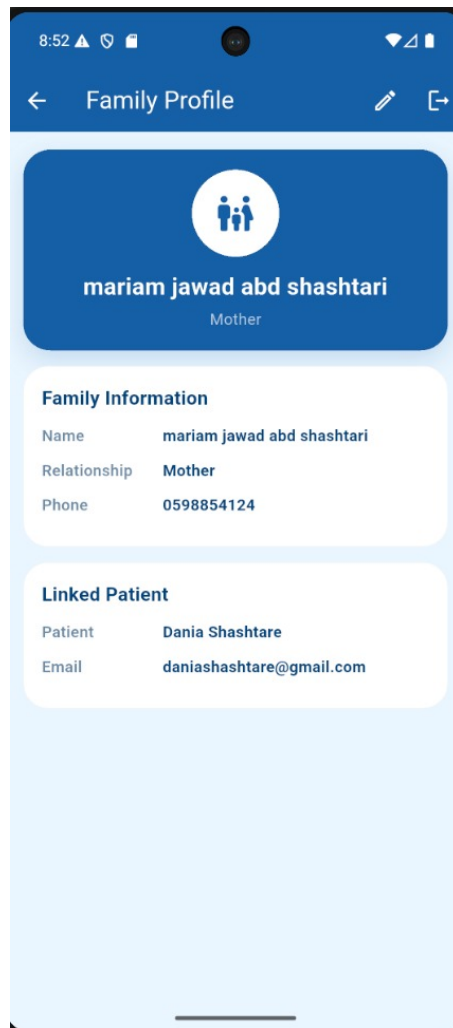
Figure 3.45: Family Alerts and Notifications

Family Profile Page

The Family Profile Page allows the family member to view their account and relationship information. This page helps confirm that the family member is connected to the correct patient account.

The profile page can show information such as the family member name, phone number, relationship to the patient, and linked patient information. This is important because the family role depends on the connection between the family member and the patient.

The family home page also includes a settings icon. This icon redirects the family member to the shared settings page, where common settings such as language, dark mode, and password options are managed. Since the settings page is shared between different roles, it is explained later in the Shared System Features section.



Family profile page

Figure 3.46: Family Profile Page in the T1D application

3.2.6 Use T1D as an Admin

The admin side of the T1D application was implemented to manage the main users of the system and maintain platform reliability. The administrator can manage patients, family accounts, doctors, and nutritionists from one dashboard. This role is important because it provides control over the system and ensures that healthcare providers are reviewed before they can fully interact with patients.

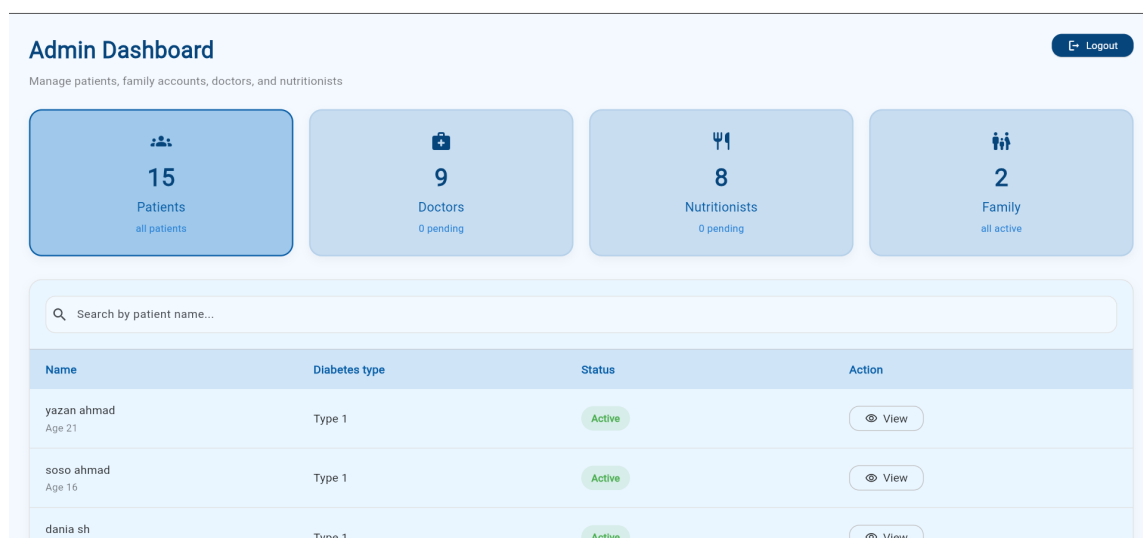
The admin dashboard displays summary statistics for the main user groups, including patients, doctors, nutritionists, and family members. Each card shows the total number of users in that category. For doctors and nutritionists, the dashboard also shows the number of pending accounts that still need review. The administrator can click on any card to display the related user table.

Admin Dashboard

The Admin Dashboard is the main page that appears after the administrator logs into the system. It provides a clear overview of the system users and allows the admin to switch between patients, doctors, nutritionists, and family accounts.

The dashboard includes four main statistic cards: Patients, Doctors, Nutritionists, and Family. These cards help the admin quickly understand the number of users in the system. The selected card is highlighted to show which section is currently displayed.

The dashboard also includes a search field that changes depending on the selected section. For example, when the patients section is selected, the admin can search by patient name. When the doctors section is selected, the admin can search by doctor name. This makes user management easier, especially when the number of users increases.



Admin dashboard with user statistics and patients table

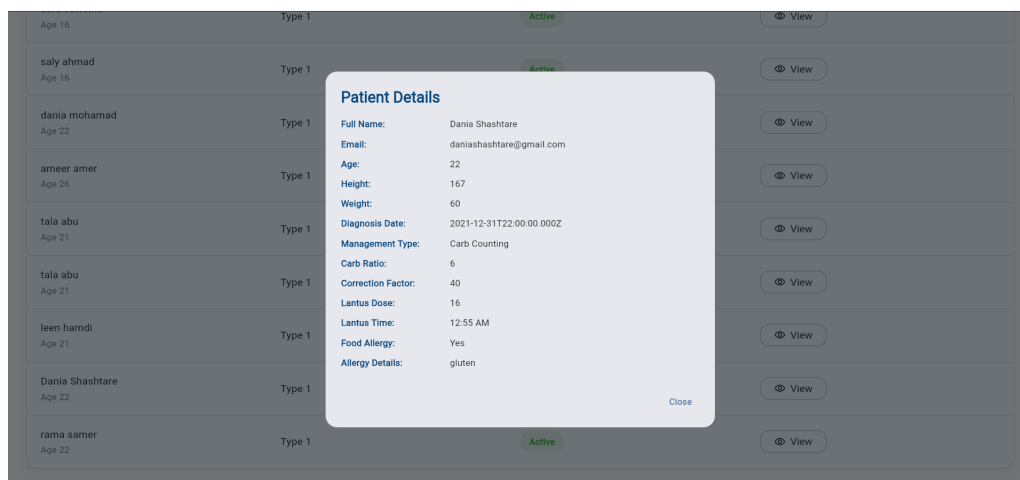
Figure 3.47: Admin Dashboard in the T1D application

User Management

The User Management feature allows the administrator to view and manage different types of users in the system. The admin can view patients, family members, doctors, and nutritionists by selecting the related card from the dashboard.

For patients, the system displays a table that includes the patient name, diabetes type, account status, and an action button. The View button opens a details dialog that shows patient information such as full name, email, age, height, weight, diagnosis date, diabetes management type, carb ratio, correction factor, Lantus dose, Lantus time, food allergy status, and allergy details.

This helps the administrator review patient accounts and check important profile information without opening the database manually. It also makes the system more organized because all patient data can be accessed from the admin interface.

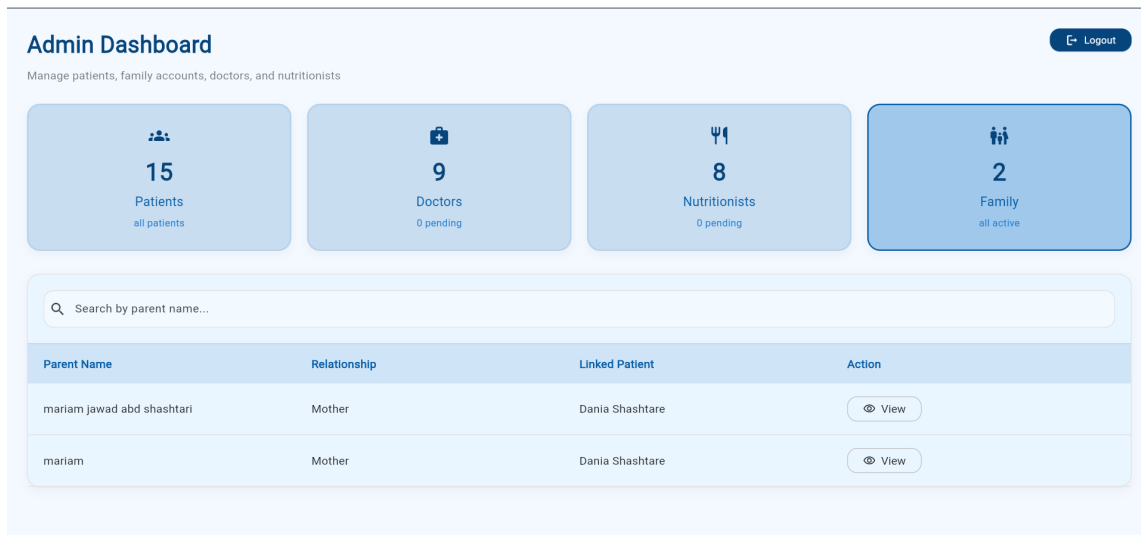


Patient details dialog

Figure 3.48: Patient Details View for Admin

Family accounts are also managed from the admin dashboard. When the Family section is selected, the system displays a table that includes the parent name, relationship, linked patient, and a View action. This allows the admin to check whether the family account is connected to the correct patient.

This feature is important because family members are allowed to monitor patient updates and receive alerts. Therefore, the admin needs a clear view of the relationship between the family member and the linked patient.

A screenshot of an Admin Dashboard. At the top, it says 'Admin Dashboard' and 'Manage patients, family accounts, doctors, and nutritionists'. There's a 'Logout' button. Below this are four summary cards: '15 Patients (all patients)', '9 Doctors (0 pending)', '8 Nutritionists (0 pending)', and '2 Family (all active)'. Below the cards is a search bar labeled 'Search by parent name...'. Underneath the search bar is a table with the following data:

Parent Name	Relationship	Linked Patient	Action
mariam jawad abd shashtari	Mother	Dania Shashtare	View
mariam	Mother	Dania Shashtare	View

Family accounts management table

Figure 3.49: Family Accounts Management in the Admin Dashboard

Doctor and Nutritionist Approval

One of the most important admin features is approving or rejecting healthcare provider accounts. Doctors and nutritionists must complete their professional onboarding forms before they can be reviewed by the administrator.

When the Doctors section is selected, the system displays a table that includes the doctor name, specialty, verification status, and View action. The verification status can be approved, rejected, or pending. This helps the admin immediately identify which doctors are already approved and which accounts need review.

Patients all patients	Doctors 0 pending	Nutritionists 0 pending	Family all active
Q Search by doctor name...			
Name	Specialty	Verification	Action
sari salameh	Diabetes Specialist	rejected	View
jenan naser	Diabetes Specialist	approved	View
sami jaber	Diabetes Specialist	approved	View
masa abu	Internal Medicine	approved	View
islam mohamad	Internal Medicine	approved	View
anan abdalhak	Diabetes Specialist	approved	View

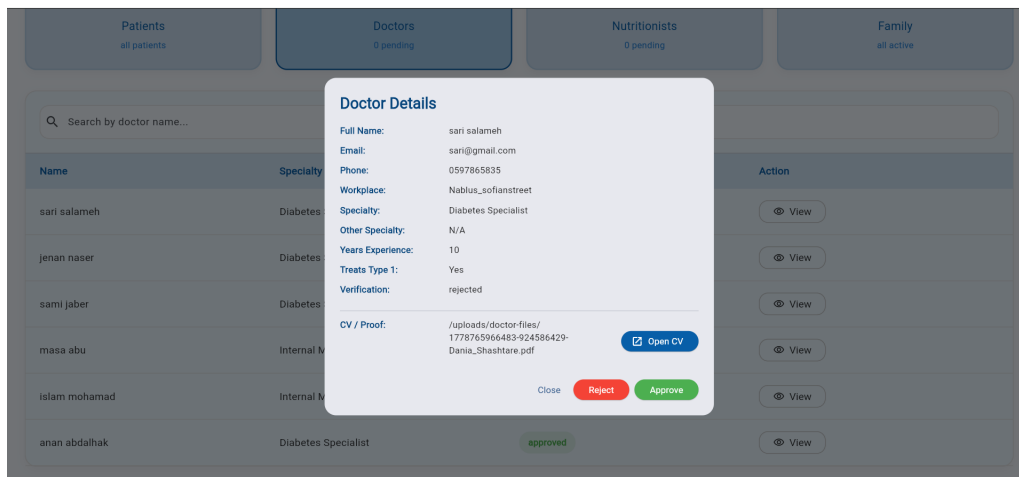
Doctors management table with verification status

Figure 3.50: Doctor Management and Verification Status

When the admin clicks View, a detailed dialog appears. This dialog displays the doctor's full name, email, phone number, workplace, specialty, other specialty if available, years of experience, whether the doctor treats Type 1 Diabetes, and current verification status.

The dialog also includes an option to open the uploaded CV or professional proof. This allows the admin to review the provider's document before making a decision. After reviewing the information, the admin can approve or reject the doctor account using the Approve and Reject buttons.

This approval process improves the safety of the platform because only reviewed healthcare providers can fully use the system and interact with patients.



Doctor details dialog with CV/proof, approve, and reject actions

Figure 3.51: Doctor Details and Approval Dialog

The same verification concept is applied to nutritionists. The admin can view nutritionist accounts, check their specialty and verification status, open their uploaded professional proof or CV, and then approve or reject the account. This ensures that nutritionists are also reviewed before providing nutrition follow-up or creating meal plans for patients.

System Monitoring

The admin dashboard also supports general system monitoring by showing the number of users in each main category. The statistics cards give the admin a quick overview of the system status, including the number of patients, doctors, nutritionists, and family members.

The system also shows pending provider accounts, which helps the admin identify accounts that need action. By using the search bar and user tables, the admin can quickly find a specific user, review details, and take the required action.

The Logout button allows the administrator to exit the admin dashboard securely. When logout is performed, the stored user information is removed and the system redirects back to the authentication screen.

Overall, the admin side provides the control layer of the T1D application. It supports user management, provider approval, account review, and system monitoring, which helps keep the application organized and safe for patients and healthcare providers.

3.2.7 Shared System Features

The T1D application includes several shared system features that are used across different roles. These features are not limited to one user type only, because patients, doctors, nutritionists, and family members can all benefit from them. The shared features include the settings page, multi-language support, and dark/light mode.

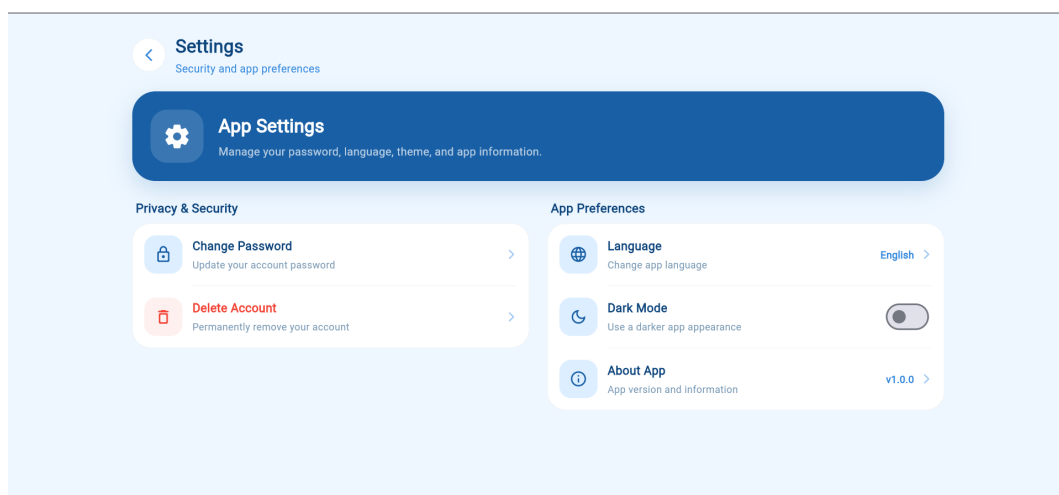
Settings Page

The Settings page allows users to manage their account security and application preferences from one place. This page is shared between the main roles in the system and can be opened from the settings icon inside the application.

The settings page contains two main sections: Privacy and Security, and App Preferences. The Privacy and Security section includes the Change Password option and the Delete Account option. The Change Password option allows the user to update the account password by entering the current password, the new password, and the confirmation password. The system validates the fields before sending the request to the backend. It checks that all password fields are filled, the new password has the required length, and the new password matches the confirmation password.

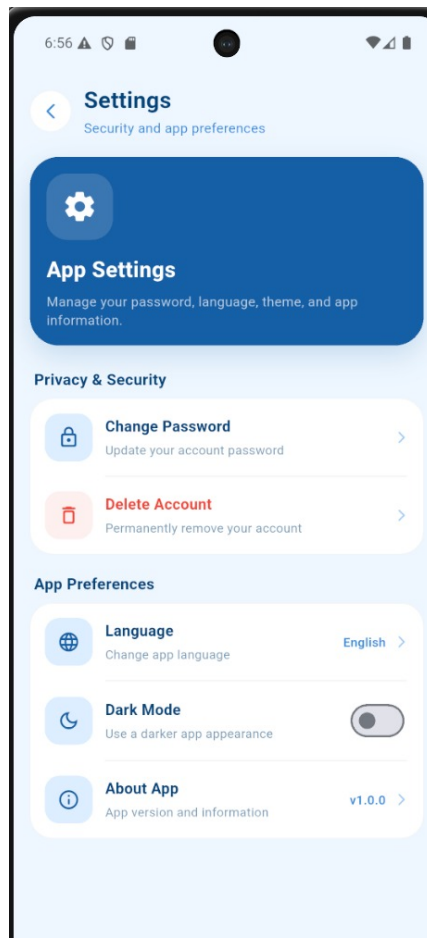
The App Preferences section includes the Language option, Dark Mode switch, and About App option. The language option allows the user to switch between English and Arabic. The dark mode switch allows the user to change the application appearance between light mode and dark mode. The About App option displays information about T1D, its purpose, and the support email.

The Settings page was designed to work on both mobile and web screens. On mobile screens, the sections are displayed vertically to make scrolling easier. On web or large screens, the settings sections are displayed side by side, which makes better use of the wider screen space.



Settings page on web

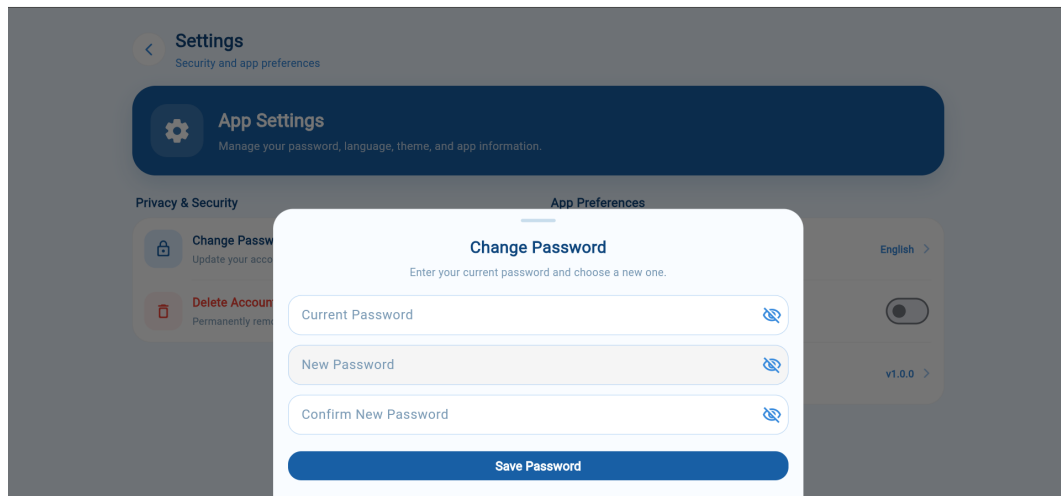
Figure 3.52: Settings Page on Web



Settings page on mobile

Figure 3.53: Settings Page on Mobile

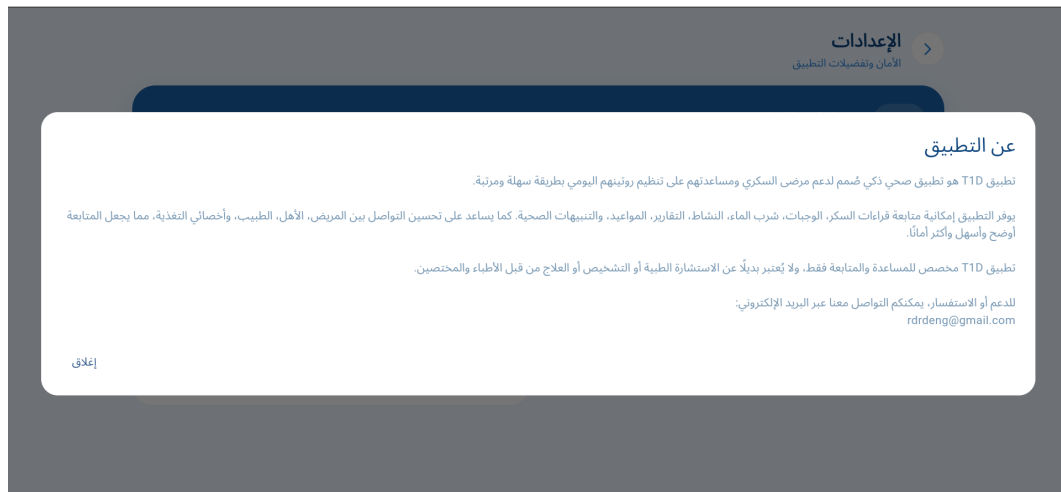
The Change Password screen appears as a bottom sheet. It asks the user to enter the current password, new password, and confirm the new password. This feature improves account security and allows users to update their password directly from the application.



Change password screen

Figure 3.54: Change Password Feature in Settings

The About App dialog explains the purpose of the T1D application. It states that the app supports diabetes follow-up and helps organize glucose readings, meals, reports, appointments, reminders, and communication between patients, family members, doctors, and nutritionists. It also explains that the application is for monitoring and support purposes and does not replace medical advice.



About app dialog

Figure 3.55: About App Information in Settings

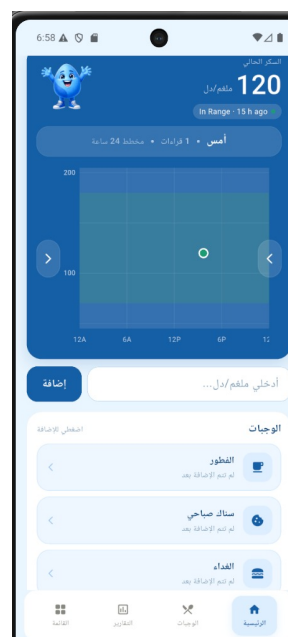
Multi-language Support

The T1D application supports both English and Arabic languages. This feature makes the application easier to use for different users, especially because the target users may prefer Arabic for daily healthcare follow-up.

The language feature is implemented through a shared settings provider and translation maps inside the application screens. When the user selects a language from the Settings page, the interface text changes according to the selected language. The application also changes the text direction. English screens are displayed from left to right, while Arabic screens are displayed from right to left.

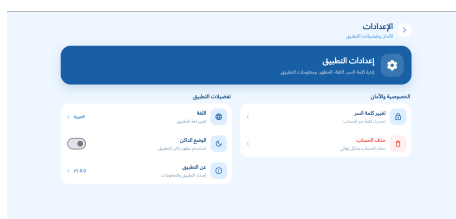
This feature is important because it improves accessibility and usability. Patients, family members, doctors, and nutritionists can use the application in the language that is more comfortable for them.

The language support works on both mobile and web screens. On mobile, the Arabic interface changes the labels, titles, and direction of the page. On web, the same language setting is applied to larger dashboard screens and shared settings pages.



Arabic language on web

Figure 3.56: Multi-language Support on Web

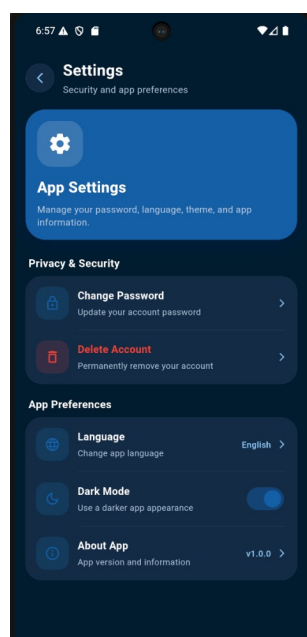


Arabic language on mobile

Figure 3.57: Multi-language Support on Mobile

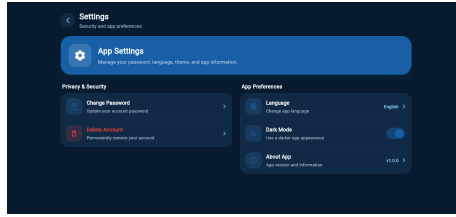
Dark Mode and Light Mode

The T1D application also supports dark mode and light mode. This feature allows users to choose the appearance that is more comfortable for them. Light mode uses a soft blue and white design, while dark mode uses darker backgrounds with lighter text to reduce eye strain. The dark mode feature is controlled from the Settings page using a switch. When the user turns on dark mode, the application updates the page background, cards, icons, text colors, and dividers. When the user turns it off, the application returns to the light appearance. This feature is shared across the system and is applied to both mobile and web interfaces. On mobile, dark mode is useful for patients and family members who may check the application frequently. On web, dark mode improves readability for dashboards used by doctors, nutritionists, and other users on larger screens.



Dark mode on web

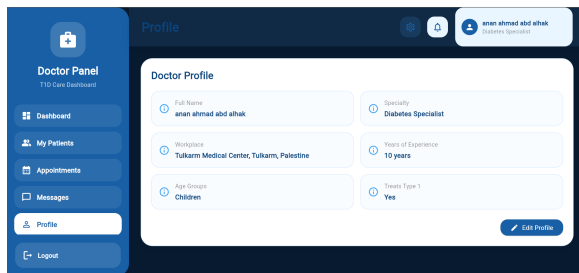
Figure 3.58: Dark Mode on Web



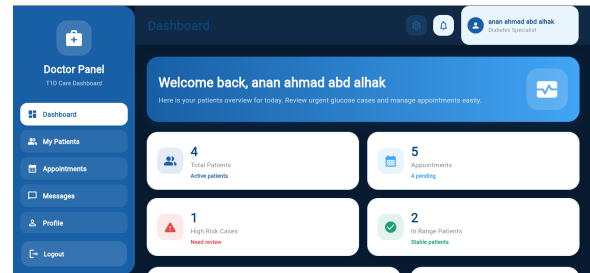
Dark mode on mobile

Figure 3.59: Dark Mode on Mobile

The system also keeps the design consistent when switching between light and dark mode. This means that the same features remain available, but the colors are adapted according to the selected theme.



(a). Dark mode example



(b). Light mode example

Figure 3.60: Light and Dark Mode Comparison in T1D

Chapter 4 — Results and Analysis

4.1 System Results

The T1D application was successfully developed as an integrated healthcare follow-up system for patients with Type 1 Diabetes. The system provides several main services in one platform, including glucose tracking, meal logging, reports, appointments, chat, notifications, family monitoring, and user management.

The application supports multiple user roles: patient, doctor, nutritionist, family member, and administrator. Each role has access to specific features based on its responsibilities. This role-based structure helps organize the system and ensures that each user can only access the functions related to their role.

The frontend of the system was implemented using Flutter, while the backend was developed using Node.js and Express.js. MongoDB was used to store the system data, including users, glucose readings, meals, appointments, chat messages, meal plans, notifications. Firebase was also used to support notifications and real-time alerts.

Overall, the system achieved its main objective by providing a centralized platform that connects patients, healthcare providers, family members, and administrators. The final result is an organized and user-friendly application that helps improve diabetes follow-up and communication.

4.2 Patient Side Results

The patient side is one of the main parts of the T1D application. It allows patients to manage their daily diabetes-related activities in an organized way. After signing in, the patient can access the home page, where important information and shortcuts are displayed clearly.

The patient can add and monitor blood glucose readings. Each glucose reading is stored in the database and can be classified according to its value. This helps the patient understand whether the reading is low, normal, or high. The glucose tracking feature provides a simple way to follow the patient's health condition over time.

The meal logging feature allows the patient to record meals and organize food intake. This helps the patient connect daily meals with glucose changes and maintain better awareness of eating habits. The reports page summarizes health data and presents it in a clear way, allowing the patient to review glucose readings during different periods.

The patient can also book appointments with doctors and nutritionists. The appointment feature helps reduce manual communication and makes scheduling more organized. In addition, the chat feature allows the patient to communicate directly with healthcare providers when follow-up or advice is needed.

The patient profile and settings pages allow users to manage personal information, change password, switch between languages, and use dark mode. These features improve usability and make the application more comfortable for different users.

4.3 Doctor Side Results

The doctor side was implemented to help doctors follow up with assigned patients more efficiently. After signing in, the doctor can access a dashboard that provides an overview of patients, appointments, and follow-up activities.

Doctors can view patient information and review glucose readings and reports. This helps doctors understand the patient's health status and identify possible patterns in blood glucose levels. Instead of depending on scattered information or manual messages, the doctor can access organized patient data from the system.

The doctor appointment feature allows doctors to manage scheduled appointments with patients. This includes viewing appointment details and following up with patient requests.

The chat feature allows doctors to communicate with patients directly through the application. This improves medical follow-up and allows patients to ask questions or receive guidance in a structured way.

The doctor profile and settings pages allow doctors to manage their account information and application preferences. Since doctor accounts require approval from the administrator, the system provides more control and safety before allowing doctors to interact with patients.

4.4 Nutritionist Side Results

The nutritionist side was implemented to support nutrition-related follow-up for Type 1 Diabetes patients. Nutritionists can sign in to the system and access their dashboard, where they can manage patients, appointments, meal plans, and communication.

The patient follow-up feature allows nutritionists to review patient progress and provide guidance based on meal records and general health information. This helps patients receive nutrition support that is connected to their diabetes management routine.

The meal plans management feature allows nutritionists to create and manage meal plans for patients. This provides patients with organized nutrition recommendations and helps them follow a healthier daily routine. The meal plan feature also supports better cooperation between the patient and the nutritionist.

Nutritionists can manage appointments with patients through the appointment page. This makes scheduling more organized and reduces the need for external communication. The chat feature allows nutritionists to communicate with patients directly and answer nutrition-related questions.

The nutritionist profile and settings pages allow nutritionists to update account information and adjust application preferences. Similar to doctors, nutritionist accounts require administrator approval before full access is granted, which helps maintain system reliability.

4.5 Family Member Side Results

The family member side was implemented to improve patient safety and support. Family members can monitor the patient's status and receive important updates through the application. The family home page provides quick access to patient-related information. This allows family members to stay aware of the patient's condition without needing to ask the patient manually every time. The monitoring feature is useful especially when the patient needs extra care or support.

The patient monitoring feature allows family members to view important diabetes-related updates, such as the latest glucose status. This helps family members respond more quickly when the patient's glucose level becomes abnormal.

Alerts and notifications are also important features for the family member role. When an important health update occurs, the system can notify the family member. This increases safety and helps family members support the patient at the right time.

The family profile and settings pages allow family members to manage their account and application preferences. This makes the family role simple, focused, and easy to use.

4.6 Admin Side Results

The admin side was implemented to manage the system and maintain platform safety. The administrator has access to a dashboard that provides management tools for users and healthcare providers.

The user management feature allows the admin to view and manage system users, including patients, doctors, nutritionists, and family members. This helps the admin monitor the system and keep user data organized.

One of the most important admin features is doctor and nutritionist approval. When a doctor or nutritionist creates an account, the admin can review the account and approve it before the provider can fully use the system. This helps ensure that healthcare providers are verified before communicating with patients.

The admin can also monitor system activity and manage important platform operations. This supports better control over the system and helps maintain a safe and organized environment for all users.

Overall, the admin side provides the needed control layer for managing users, approving providers, and supporting system reliability.

4.7 Feature Analysis

The implemented features of T1D were analyzed based on their role in improving diabetes follow-up, communication, organization, and user experience.

The glucose tracking feature is one of the most important parts of the system because it allows patients to record and review blood glucose readings. This supports better awareness of the patient's condition and provides useful data for doctors.

The meal logging and meal plan features help connect nutrition management with diabetes follow-up. Patients can record their meals, while nutritionists can provide structured meal plans. This improves the nutrition support process and makes it more organized.

The reports feature helps summarize patient data in a clear way. Instead of reviewing individual readings only, users can view organized reports that support better understanding and follow-up. The appointment feature improves communication between patients, doctors, and nutritionists by providing a structured booking process. It helps reduce missed appointments and makes medical follow-up easier.

The chat feature supports direct communication between patients and healthcare providers. This reduces the need to use external messaging applications and keeps communication within the healthcare system.

The family monitoring and notification features improve patient safety. By allowing family members to receive alerts and monitor patient status, the system provides an additional support layer for patients.

The multi-language support and dark mode features improve accessibility and usability. Arabic and English support makes the application easier to use for different users, while dark mode provides a more comfortable viewing experience.

In general, the T1D application achieved its intended result by combining several diabetes management services into one integrated platform. The system reduces the need for separate tools and improves communication between patients, doctors, nutritionists, family members, and administrators.

Chapter 5 — Discussion

5.1 Goal Achievement

The main goal of the T1D application was to develop an integrated healthcare follow-up system that supports patients with Type 1 Diabetes in managing their daily health routine. The system aimed to organize diabetes-related information, improve communication with healthcare providers, and allow family members to monitor important patient updates.

This goal was achieved by implementing a multi-role application that supports patients, doctors, nutritionists, family members, and administrators. Each role has access to specific features according to its responsibilities. Patients can record glucose readings, log meals, view reports, book appointments, and communicate with doctors and nutritionists. Doctors can monitor patient data, review glucose reports, manage appointments, and communicate with patients. Nutritionists can follow up with patients and manage meal plans. Family members can monitor patient status and receive important alerts, while administrators can manage users and approve healthcare providers.

The application also achieved its goal of improving organization by storing patient data in one centralized system. Instead of using separate tools for glucose tracking, meal logging, appointments, reports, and communication, T1D combines these services in one platform. This makes the follow-up process easier for patients and more useful for healthcare providers.

Another achieved goal is improving accessibility and usability. The system supports Arabic and English languages, dark mode, and role-based interfaces. These features make the application easier to use for different users and improve the overall user experience.

Overall, the project successfully achieved its main objectives by providing a practical digital solution that supports Type 1 Diabetes follow-up and improves communication between patients, healthcare providers, and family members.

5.2 Actual Contribution

The actual contribution of the T1D application is providing a complete healthcare follow-up platform focused on Type 1 Diabetes management. The system contributes by combining several important diabetes-related services into one application instead of leaving users dependent on multiple separate tools.

For patients, the application provides a simple way to record and monitor glucose readings, log meals, view reports, book appointments, and communicate with healthcare providers. This helps patients manage their condition in a more organized way and gives them better awareness of their health status.

For doctors, T1D provides access to patient glucose readings and reports, which helps improve medical follow-up. Doctors can monitor patient progress and communicate with patients through the system. This makes the follow-up process more structured and reduces dependence on scattered communication methods.

For nutritionists, the application supports nutrition follow-up by allowing them to manage meal plans and communicate with patients. This is important because meal planning plays a major role in diabetes management.

For family members, T1D provides a monitoring role that helps them stay updated about the patient's condition. This adds an extra safety layer, especially when the patient needs support or when abnormal glucose readings occur.

For administrators, the application provides tools to manage users and approve doctors and nutritionists before allowing them to use the system fully. This improves platform safety and helps ensure that healthcare providers are reviewed before interacting with patients.

The project also contributes technically by applying a full-stack development approach using Flutter for the frontend, Node.js and Express.js for the backend, MongoDB for the database, and Firebase for notifications. This creates a flexible system that can be expanded in the future.

5.3 Strengths and Limitations

The T1D application has several strengths that make it useful as a healthcare follow-up platform. One of the main strengths is that it combines multiple diabetes management features in one system. Patients can track glucose readings, log meals, view reports, book appointments, communicate with healthcare providers, and receive notifications without needing to use separate applications.

Another strength is the role-based structure of the system. Each user role has its own interface and permissions, which makes the application organized and easier to use. Patients, doctors, nutritionists, family members, and administrators each have features that match their needs.

The system also supports better communication between patients and healthcare providers through the chat feature. This allows patients to ask questions and receive follow-up in a more direct and organized way.

Family monitoring is another important strength. By allowing family members to monitor patient status and receive alerts, the system improves patient safety and provides additional support.

The application also provides accessibility features such as Arabic and English language support and dark mode. These features improve usability and make the application more comfortable for different users.

However, the system still has some limitations. One limitation is that the application currently depends on manual data entry for glucose readings and meals. This means that the accuracy of the data depends on the user entering information correctly and regularly.

Another limitation is that the system does not currently integrate directly with glucose monitoring devices or insulin pumps. Such integration could improve accuracy and reduce manual effort, but it requires additional hardware support and medical device compatibility.

The application also provides reports based on stored data, but it does not yet include advanced medical analysis or smart prediction. Future versions could include more intelligent analysis to help detect patterns and provide recommendations.

In addition, the system requires internet access to communicate with the backend and receive notifications. This may limit usage in situations where the internet connection is weak or unavailable.

Despite these limitations, T1D provides a strong foundation for a healthcare follow-up system and can be improved with additional features in future development.

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