People's Democratic Republic of Algeria
Ministry of Higher Education and Scientific Research
Abou Bakr Belkaid University - Tlemcen

Faculty of Sciences
Department of Computer Science

Master Thesis

Submitted in partial fulfillment of the requirements for the

Master's Degree

Field: Computer Science

Specialization**:** Software Engineering (SE)

Presented by: BECHLAGHEM YACINE ABDEL ILLAH

Subject

Design And Implementation of a Management Solution for a Hemodialysis Clinic

Presented publicly on: 22/06/2026

Before the Jury Composed of:

Mr.BENAMAR ABDELKRIM (Supervisor)
Mr. ABDERRAHIM ALAEDDINE (President)
Mrs.BENFRIHA SIHEM (Examinator)
Mrs.BELEDGHEM RAFIKA (I2E Expert)

Academic year: 2025/2026

Table of contents

List of Figures

List of Tables

Abbreviations List

UML	Unified Modeling Language
API	Application Programming Interface
ORM	Object-Relational Mapping
JWT	JSON Web Token
SQL	Structured Query Language
DB	Database
UI	User Interface
REST	Representational State Transfer
CSS	Cascading Style Sheets
HTML	HyperText Markup Language
CRUD	Create Read Update Delete

DEDICATION

To my father, for his sacrifices, hard work, and unwavering support throughout my life.

Thank you for always believing in me and encouraging me to pursue my goals.

To my mother, for her endless love, patience, prayers, and constant encouragement.

Your support has been a source of strength during every stage of my journey.

To my sister, for her guidance, encouragement, and valuable contribution to this project.

As a member of the Nephrology Department at the CHU of Tlemcen, she inspired

the idea behind this work and helped me better understand

the real challenges faced in hemodialysis care.

To my friends, for their support, encouragement, and the memorable moments

we shared throughout this academic journey. Your friendship, advice,

and motivation helped make this experience both enjoyable and rewarding.

Acknowledgement

First and foremost, I would like to praise Allah the Almighty, the Most Gracious, and the Most Merciful for His blessing given to us during our studies and in completing this thesis. May Allah's blessing goes to His final Prophet Muhammad (peace be upon him), his family and his companions.

I would like to acknowledge my sincere appreciation to my supervisor **Mr.BENAMAR ABDELKRIM** for his encouragement, assistance and availability to finish the thesis. his expertise and encouragement have been invaluable to my success.

I would also like to express my sincere gratitude to **Mrs. BENFRIHA SIHEM** for accepting to examine this thesis, to **Mr. ABDERRAHIM ALAEDDINE** for kindly accepting to serve as President of the jury, and to **Mrs. BELEDGHEM RAFIKA** for her valuable participation as an I2E Expert.

my deepest gratitude goes to my parents, for their unconditional love, wise guidance, and continuous moral and financial support, which have allowed me to pursue my studies and complete this thesis.

Finally, we warmly thank our friends and colleagues, for their constant support, enriching discussions, and encouragement throughout this academic journey.

General Introduction

General Context of Hemodialysis Clinics:

Hemodialysis [is a vital treatment for patients suffering from chronic kidney failure. In Algeria, this condition represents an important health concern. According to a study conducted between 2015 and 2018, around **25,000 Algerian patients** were undergoing hemodialysis treatment [20]. This number shows the high demand placed on hemodialysis clinics and the importance of improving their organization.

Hemodialysis patients require regular sessions, continuous medical monitoring, and accurate follow-up. Therefore, clinics must manage different types of information, such as patient records, dialysis sessions, appointments, laboratory results, medical prescriptions, administrative documents, and staff activities.

Figure 1: Hemodialysis session.

However, in many local clinics, these tasks are still managed using paper-based methods or separate files, which can make access to information difficult and increase the risk of delays or missing data. Since dialysis care depends on precision and coordination between doctors, nurses, secretaries, and managers, poor organization can affect both patient care and clinic efficiency.

For this reason, digital management systems [22] have become essential to improve data organization, facilitate access to patient information, support medical decision-making, and reduce administrative workload.

Problem Statement:

Figure 2: Paper-based medical records.

Despite the importance of digitalization, many local hemodialysis clinics still rely on paper-based methods or separate files to manage patient information, and administrative documents. This can lead to fragmented data, difficulty accessing updated information, duplication of records.

Since hemodialysis patients require regular treatment and continuous monitoring, any missing or delayed information can affect coordination between doctors, nurses, secretaries, and managers. This makes daily work more difficult and can reduce the efficiency of the clinic.

In addition, some existing software solutions are either too general for dialysis workflows or too complex for small and medium-sized clinics. Internet connectivity problems can also interrupt online systems and affect daily clinic activities, especially when access to patient data is needed during treatment.

Proposed Solution:

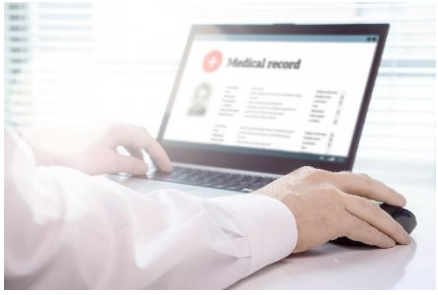


Figure 3: Digital healthcare management.

To address these problems, this project proposes a design and implementation of a hemodialysis clinic management system. The proposed platform aims to centralize the main clinic activities in one system, including patient management, dialysis session scheduling, medical follow-up, laboratory results, appointments, staff management, and administrative documents.

The proposed solution is based on a hybrid architecture composed of a web application and a desktop application. The web version allows access to the system through a hosted database, while the desktop version supports local operation using a local database. A synchronization mechanism ensures data consistency between the online and offline environments when internet connection becomes available.

Through this solution, the system aims to improve patient monitoring, simplify administrative tasks, ensure better coordination between clinic staff, and provide a reliable working environment adapted to the real needs of hemodialysis clinics.

Thesis Outline:

This thesis is structured into three chapters as follows:

- Chapter 1: Explain the project context and conducts a comparative study on various hemodialysis clinics Management System.

- Chapter 2: Presents the analysis and detailed design of the hemodialysis clinics Management System, constructing associated diagrams.

- Chapter 3: Introduces the development environment and the various tools used for implementing the web platform hemodialysis clinics Management System

We end our work with a general conclusion and some perspectives that could lead to future extensions of our system.

Chapter 1:
Existing Systems Comparison

1.1 Introduction:

Hemodialysis clinics handle patients suffering from chronic kidney failure, requiring regular treatment sessions, strict medical follow-up, and accurate documentation of clinical parameters. In this context, the use of specialized management systems has become essential to ensure the quality of care, improve operational efficiency, and reduce medical risks.

However, despite the availability of several digital solutions, many dialysis clinics still face challenges related to data organization, patient monitoring, and coordination between medical staff and external healthcare institutions.

This chapter aims to study and analyze existing hemodialysis management systems in order to identify their strengths and limitations. This analysis will serve as a foundation for proposing a system better adapted to the real needs of dialysis clinics.

1.2 Hemodialysis Overview:

Hemodialysis [21] is a medical treatment used for patients suffering from chronic kidney failure. When the kidneys are no longer able to properly filter waste products, excess fluids, and toxins from the blood, hemodialysis performs this function artificially through a dialysis machine.

During a hemodialysis session, the patient's blood is circulated through a dialyzer, commonly referred to as an artificial kidney. The dialyzer removes waste substances, excess water, and harmful toxins before returning the cleaned blood to the patient. This process helps maintain the body's chemical balance and supports vital physiological functions.

Patients with end-stage renal disease usually require regular hemodialysis sessions several times per week. Consequently, dialysis centers must ensure accurate patient monitoring, proper treatment scheduling, and continuous medical follow-up.

Because hemodialysis treatment involves a large amount of clinical and administrative information, healthcare professionals require efficient management systems to organize patient records, treatment plans, laboratory results, and dialysis session data.

1.3 Challenges of Hemodialysis Clinic Management:

Managing a hemodialysis clinic involves several challenges due to the complexity of patient care and the large amount of information that must be handled daily.

One of the main challenges is the management of patient records. Medical staff must continuously update patient information, treatment plans, laboratory results, prescriptions, and dialysis history. Maintaining accurate and accessible records is essential for ensuring quality healthcare services.

Another challenge concerns the scheduling and organization of dialysis sessions. Since patients require regular treatments according to predefined schedules, clinics must efficiently allocate dialysis stations, medical staff, and treatment time slots while avoiding scheduling conflicts.

Coordination between doctors, nurses, secretaries, and managers also represents an important challenge. Effective communication is necessary to ensure that medical instructions, patient follow-up activities, and administrative tasks are performed correctly and on time.

In addition, many healthcare facilities still rely on paper-based records or fragmented information systems, which can lead to data duplication, information loss, and difficulties in accessing updated patient information. Internet connectivity problems may also affect the availability of online systems and disrupt clinic operations.

For these reasons, modern digital management solutions have become essential for improving operational efficiency, supporting medical decision-making, and ensuring better coordination among healthcare professionals.

1.4 Similar Systems:

In this section, we present a set of existing systems used in the management of dialysis clinics or similar healthcare environments.

1.4.1 Nipro NephroFlow:

A-Overview:

NephroFlow is a specialized dialysis management platform developed by Nipro to support the complete workflow of hemodialysis centers. The system assists healthcare professionals in managing patient records, dialysis treatments, prescriptions, laboratory results, scheduling, and clinical documentation. In addition, it enables near real-time monitoring of dialysis sessions through integration with dialysis machines and other medical devices, reducing manual data entry and improving the quality of patient care. [1].

B- Platform / Architecture:

NephroFlow is a web-based platform that supports both cloud-based and on-premises deployment. Users access the system through a web interface, while dedicated integration modules communicate with dialysis machines, weighing scales, water treatment systems, and Hospital Information Systems (HIS). Its modular architecture allows healthcare organizations to deploy only the components required for their operational workflow.

C- Advantages:

- Integrated management of patient records, treatments, laboratory results, billing, and inventory.
- Dialysis-specific Electronic Health Record (EHR).
- Integration with dialysis machines and laboratory systems.
- Offline support for selected treatment workflows with automatic cloud synchronization.

D- Limitations:

- Primarily designed for medium and large dialysis centers.
- Full functionality depends on compatible dialysis equipment and medical devices.
- Deployment and maintenance require specialized technical resources.
- Places greater emphasis on clinical workflows than administrative management.

1.4.2 RenalGenie :

A-Overview:

RenalGenie is a dialysis-specific Electronic Health Record (EHR) and clinic management system developed by RenalWorks. It centralizes patient information, dialysis treatments, prescriptions, laboratory data, billing, inventory management, scheduling, and operational reporting into a single platform. The system is designed to improve both clinical and administrative workflows within dialysis centers.[2].

B- Platform / Architecture:

RenalGenie is a cloud-based web application accessed through a standard web browser. Although the platform operates primarily in the cloud, it supports offline functionality for selected critical modules, allowing healthcare professionals to continue recording essential treatment information during temporary Internet interruptions. Once connectivity is restored, the locally stored data is synchronized automatically with the cloud database.

C- Advantages:

- Integrated management of patient records, treatments, laboratory results, billing, and inventory.
- Dialysis-specific Electronic Health Record (EHR).
- Integration with dialysis machines and laboratory systems.
- Offline support for selected treatment workflows with automatic cloud synchronization.

D- Limitations:

- Primarily relies on cloud infrastructure for daily operation.
- Offline functionality is limited to selected modules.
- Advanced integrations may require compatible medical equipment.
- Deployment and customization generally require vendor support.

1.4.3 Clinicea Dialysis EMR:

A-Overview:

Clinicea is a cloud-based clinic management and Electronic Medical Record (EMR) platform that provides specialized support for nephrology and dialysis centers. The platform includes patient registration, appointment scheduling, dialysis treatment management, Electronic Medical Records, prescriptions, laboratory management, billing, pharmacy management, telemedicine, and business analytics within a unified system.[3].

B- Platform / Architecture:

Clinicea is a cloud-based Software-as-a-Service (SaaS) web application hosted on Microsoft Azure. Healthcare professionals access the platform through a web browser without installing desktop software. The system supports multiple clinics through centralized cloud infrastructure while providing automatic backup, high availability, and secure online access.

C- Advantages:

- Integrated management of patient records, appointments, billing, pharmacy, laboratory, and inventory.
- Specialized Electronic Medical Record (EMR) for nephrology and dialysis clinics.
- Intelligent scheduling of dialysis sessions.
- Multi-center management with cloud-based access.

D- Limitations:

- Requires reliable Internet connectivity because it operates entirely in the cloud.
- Does not provide a dedicated desktop application for offline operation.
- Advanced functionality may exceed the requirements of small dialysis clinics.
- Subscription-based SaaS model may increase long-term operating costs.

1.4.4 DiMS :

A-Overview:

DiMS is a comprehensive dialysis management system developed to digitalize clinical, administrative, operational, and financial workflows within dialysis centers. The platform integrates patient management, treatment documentation, billing, accounting, inventory, asset maintenance, quality analysis, reporting, and AI-assisted clinical documentation into a unified solution suitable for both single-center and multi-center organizations.[4].

B- Platform / Architecture:

DiMS is a web-based dialysis management platform that operates through modern web browsers on desktops, laptops, and tablets. The system is deployed using a hybrid cloud infrastructure and supports integration with dialysis machines, weighing scales, laboratory providers, face recognition systems, and accounting software. Its centralized architecture enables secure access, cloud backup, role-based permissions, and centralized management across multiple dialysis centers.

C- Advantages:

- Comprehensive management of clinical, administrative, financial, and inventory processes.
- Integration with dialysis machines, laboratory providers, and weighing scales.
- AI-assisted clinical documentation and patient summaries.
- Extensive reporting and dialysis quality analysis.

D- Limitations:

- Primarily depends on Internet connectivity because it is a web-based platform.
- Full implementation may require integration with multiple external systems.
- Advanced modules may increase deployment complexity for smaller clinics.
- Some AI and integration features require additional configuration and supporting infrastructure.

1.5 Comparative Table:

Feature	Nipro NephroFlow	RenalGenie	Clinicea	DiMS	Proposed System
Dialysis Session Monitoring	Supported	Supported	Supported	Supported	**Supported**
Patient Record Management	Supported	Supported	Supported	Supported	**Supported**
Treatment Management	Supported	Supported	Supported	Supported	**Supported**
Medical Report Generation	Supported	Supported	Supported	Supported	**Supported**
Document Management	Supported	Supported	Supported	Supported	**Supported**
Role-Based Access	Supported	Supported	Supported	Supported	**Supported**
Desktop Application	Not Supported	Not Supported	Not Supported	Not Supported	**Supported**

Table 1: Feature Comparison of Existing Hemodialysis Management Systems

The following table presents a comparison between the studied systems and the proposed system based on several important criteria.

1.6 Analysis:

The table above shows that existing hemodialysis management systems provide important functionalities, but each one of them has its strengths and weaknesses.

Nipro NephroFlow stands out for its advanced dialysis session monitoring capabilities and support for clinical workflow management. However, it lacks comprehensive administrative features.

RenalGenie offers a balanced solution by combining clinical and administrative functionalities, including scheduling, equipment management, and offline operation. However, its extensive feature set and enterprise-oriented design may be more suitable for large organizations, while smaller clinics may require a simpler and more focused solution.

Clinicea provides a modern cloud-based platform with strong support for medical documentation and patient follow-up. However, it lacks certain operational features such as inventory management and structured coordination with hospitals.

DiMS distinguishes itself by offering a highly integrated platform that combines clinical monitoring, administrative management, and operational control, including inventory tracking, billing, and machine integration. However, its complexity and infrastructure requirements may limit its usability in smaller clinics or environments requiring simpler and more flexible systems.

Overall, while these systems offer valuable capabilities, they differ in their focus, complexity, and deployment approach. Some emphasize clinical monitoring, while others provide broader administrative and operational functionalities.

To address these differences, the proposed system is designed to combine clinical monitoring and administrative workflow management within a single platform. Unlike complex enterprise solutions, it focuses on simplicity, efficiency, and adaptability to the needs of small and medium-sized dialysis clinics. In addition, it provides offline operation through a desktop application and synchronization mechanism, ensuring continuous access to data in environments with unstable internet connectivity.

1.7 Conclusion:

Chapter 1: Existing Systems Comparison

Through this chapter, the proposed current hemodialysis management systems offer valuable functionalities that contribute to improving patient care and clinic operations.

Because these systems present several limitations, the proposed system aims to address these limitations by providing a comprehensive solution that integrates medical, administrative, and operational aspects within a single platform, while ensuring better organization, traceability, and coordination of patient care.

In order to achieve these objectives, it is necessary to define the system requirements and design a structured solution adapted to the identified needs. Therefore, the following chapter focuses on the analysis and conception of the proposed system, including the specification of requirements and the modeling of its architecture.

Chapter 2:
System design

2.1 Introduction:

Following the analysis of existing systems presented in the previous chapter, it becomes necessary to define and design a solution that meets the specific needs of hemodialysis clinics.

This chapter focuses on the conception and design of the proposed system. It begins with the identification and specification of system requirements, both functional and non-functional, which serve as the foundation for the system development. These requirements are derived from the real operational needs of the different actors involved in the clinic, including doctors, secretaries, and managers.

Subsequently, a detailed modeling of the system is carried out using Unified Modeling Language (UML) diagrams. These diagrams provide a structured and visual representation of the system's behavior and architecture, including use case diagrams, sequence diagrams, and class diagrams. They allow a better understanding of interactions between users and the system, as well as the organization of data and functionalities.

2.2 Requirements Specification:

2.2.1 Functional Requirements:

Functional requirements describe the different operations that the system must perform. These requirements are defined according to the roles of the system users.

1. Doctor:

The doctor is responsible for the medical monitoring and treatment of patients undergoing hemodialysis.

The system must allow the doctor to:

- Access and view complete patient medical records
- Review dialysis session history and clinical parameters
- Manage patient treatment plans
- Prescribe medications with dosage and duration
- Generate medical reports for patient follow-up

2. Secretary:

The secretary is responsible for managing the administrative side of the system.

The system must allow the secretary to:

- Register new patients and update their information
- Manage patient records (non-medical data)
- Schedule and manage appointments
- Schedule dialysis sessions and assign patients to available machines
- Search for patient information efficiently
- Manage staff daily attendance

3. Manager (Administrator):

The manager supervises the overall functioning of the system and ensures proper resource management.

The system must allow the manager to:

- Manage user accounts and assign roles
- View patient records for administrative supervision
- View system reports related to clinic activity
- Manage dialysis stations and machine availability
- Backup system data

4. Nurse:

The nurse is responsible for monitoring and recording dialysis treatment execution for patients.
The system must allow the nurse to:
• View assigned dialysis sessions and patient information
• Record dialysis session execution details
• Monitor and update patient vital signs during treatment
• Record pre- and post-dialysis measurements
• Add nursing notes and observations
• Follow and review doctor-prescribed treatment instructions

2.2.2 Non-Functional Requirements:

1. Security:

The system must ensure the protection of sensitive medical data by:

- Implementing user authentication and role-based access control
- Preventing unauthorized access to patient information

2. Usability:

The system must provide:

- A simple and intuitive user interface
- Easy navigation between different functionalities
- Clear and readable presentation of information

3. Reliability:

The system must:

- Ensure data consistency and accuracy
- Minimize system failures and errors
- Provide stable operation during daily use

4. Maintainability:

The system must:

- Be easy to update and maintain
- Allow future improvements and feature extensions

5. Compatibility:

The system must:

- Be accessible through standard web browsers

2.3 Actors:

2.3.1 Doctor:

The doctor is responsible for the medical monitoring of dialysis patients. The doctor accesses patient medical records, reviews laboratory results, and manages treatment plans. They can also prescribe medications and update patient treatment information based on the patient's medical condition. Their main objective is to ensure accurate medical follow-up and support clinical decision-making.

2.3.2 Secretary:

The secretary manages the administrative aspects of the clinic. This includes registering new patients, updating patient information, searching patient records, and scheduling dialysis sessions or appointments, managing staff. The secretary ensures the proper organization of patient data and the smooth management of daily clinical activities.

2.3.3 Manager (Administrator):

The manager is responsible for supervising the overall functioning of the system. The manager manages user accounts, assigns user roles, monitors patient records, manages dialysis stations, consults system reports, and performs data backup operations. This role ensures that the system operates efficiently and supports the proper organization of administrative and operational activities within the clinic.

2.3.4 Nurse:

The nurse is responsible for monitoring and recording dialysis session execution details. The nurse follows the doctor’s prescribed treatment instructions, records patient vital information such as blood pressure and weight measurements, and updates session progress and nursing observations. This role ensures accurate treatment execution and continuous patient monitoring during dialysis sessions.

2.4. System design:

2.4.1 Use Case Diagrams:

Manager:

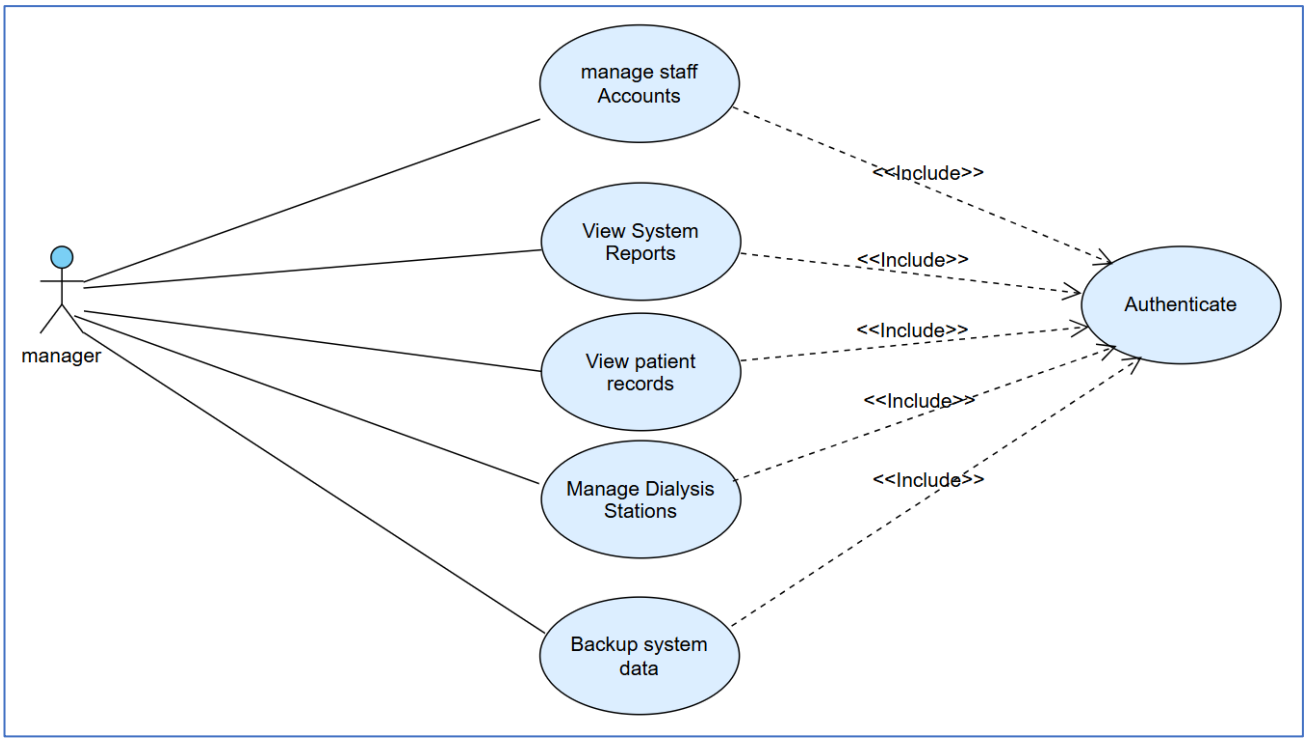


Figure 4: Manager Use-case Diagram

UC-A1: Manage Staff Accounts

The manager creates and manages user accounts for doctors, secretaries, nurses, and managers.

UC-A2: View System Reports

The manager accesses system-generated reports related to clinic activity, resource usage, and operational performance.

UC-A3: View Patient Records

The manager can access and view patient records to monitor patient information, treatment history, and overall clinic activity. This functionality provides administrative visibility without modifying medical data

UC-A4: Manage Dialysis Stations

The manager manages dialysis stations, machine information, availability status, and maintenance data.

UC-A5: backup system data

The administrator creates backups of the system database and important medical information. It ensures data protection and recovery in case of system failure or data loss.

Doctor:

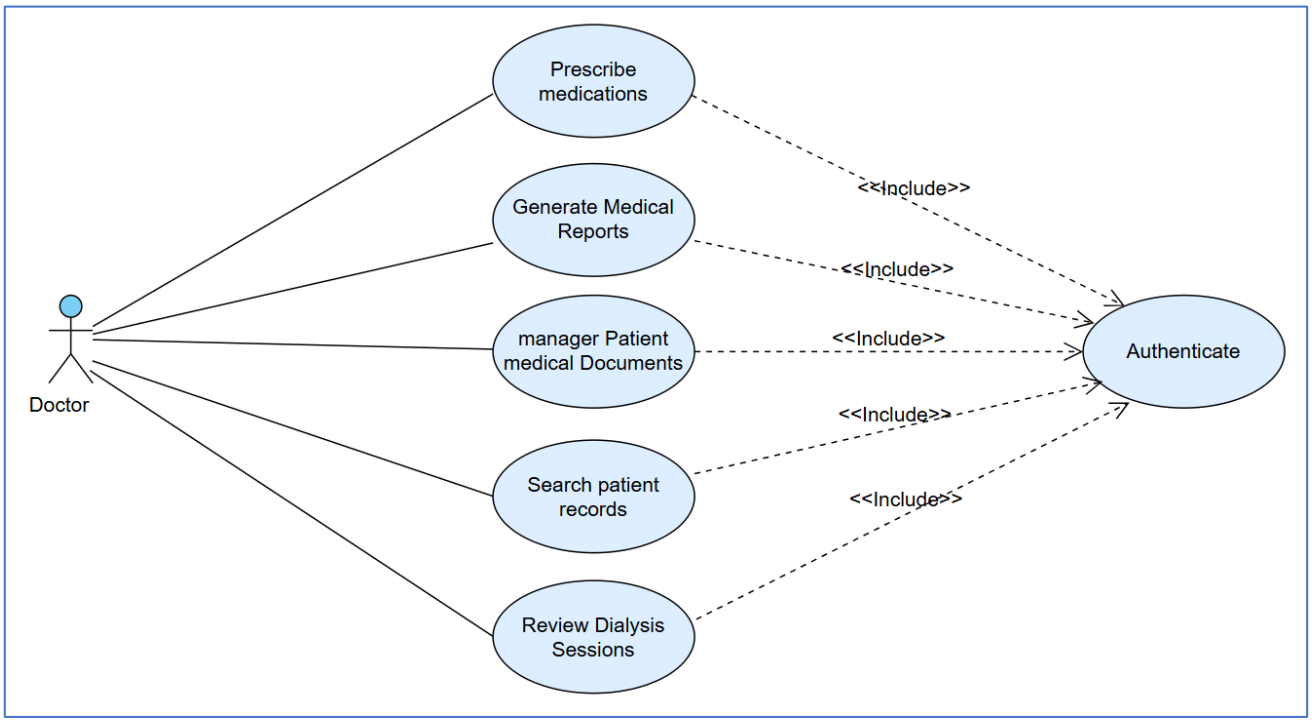


Figure 5: Doctor Use-case Diagram

UC-B1: Prescribe Medications

The doctor prescribes medications for patients by specifying dosage, frequency, and duration based on medical evaluation.

UC-B2: Generate Medical Report

The doctor generates medical reports containing patient history, treatment details, and clinical observations for referrals or medical procedures.

UC-B3: Manage Medical Information

The doctor updates stable medical information such as kidney failure cause, vascular access type, blood group, allergies, comorbidities, clinical status, and medical notes.

UC-B4: Manage Patient medical Documents

The doctor accesses and reviews complete patient medical records, including dialysis sessions, laboratory results, prescriptions, and previous diagnoses.

UC-B5: Search Patient Records

The doctor searches for patients using criteria such as name or identifier to quickly access their medical information

UC-B6: Review Dialysis Sessions

The doctor reviews current and previous dialysis sessions, including weights, blood pressure, dry weight, target weight loss, session duration, doctor instructions, and nurse notes.

Secretary:

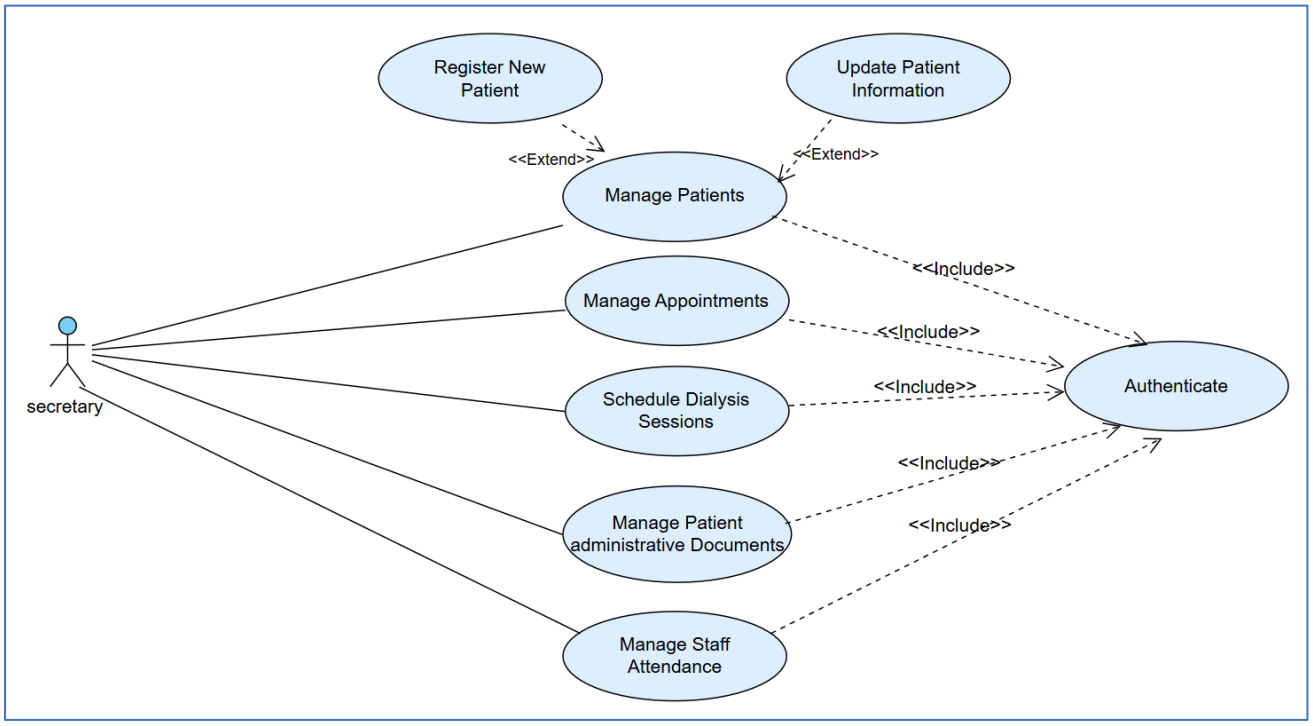


Figure 6: Secretary Use-case Diagram

UC-C1: Manage Patient

The secretary manages patient information, including registering new patients and updating personal and administrative data.

UC-C2: Manage Appointments

The secretary creates, updates, and cancels patient appointments to ensure proper scheduling and organization.

UC-C3: Schedule Dialysis Sessions

The secretary assigns a patient to one of the predefined dialysis waves. The system automatically generates upcoming dialysis sessions based on the selected wave.

UC-C4: Manage Patient Administrative Documents

The secretary handles patient-related documents by uploading, storing, and retrieving files.

UC-C5: Manage Staff Attendance

The secretary records and monitors daily staff attendance, including check-in and check-out times.

Nurse:

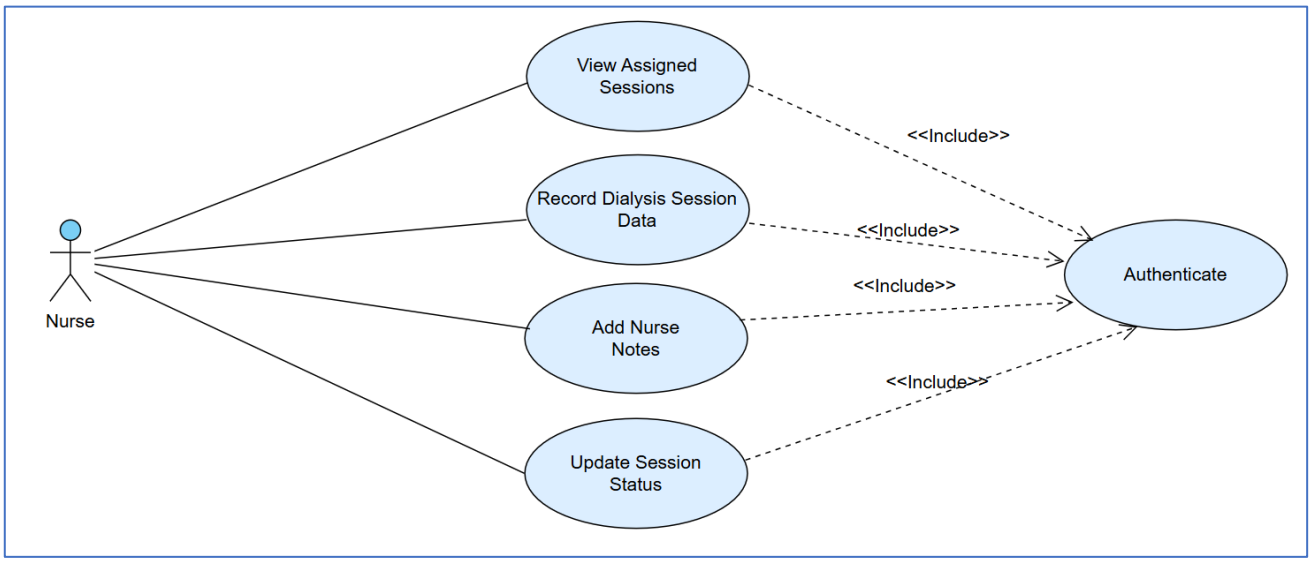


Figure 7: Nurse Use-case Diagram

UC-D1: View Assigned Sessions

The nurse views the dialysis sessions assigned for the current day, including patient information, session time, shift, and station assignment.

UC-D2: Record Dialysis Session Data

The nurse records the required treatment data during the dialysis session, including pre-session and post-session measurements, blood pressure values, dry weight, target weight loss, and session duration.

UC-D3: Add Nurse Notes

The nurse adds clinical observations and notes related to the patient's condition during or after the dialysis session.

UC-D4: Update Session Status

The nurse updates the status of the dialysis session, such as in progress, completed, missed, or cancelled, to reflect the real-time progress of the treatment.

2.4.2 Sequence Diagrams:

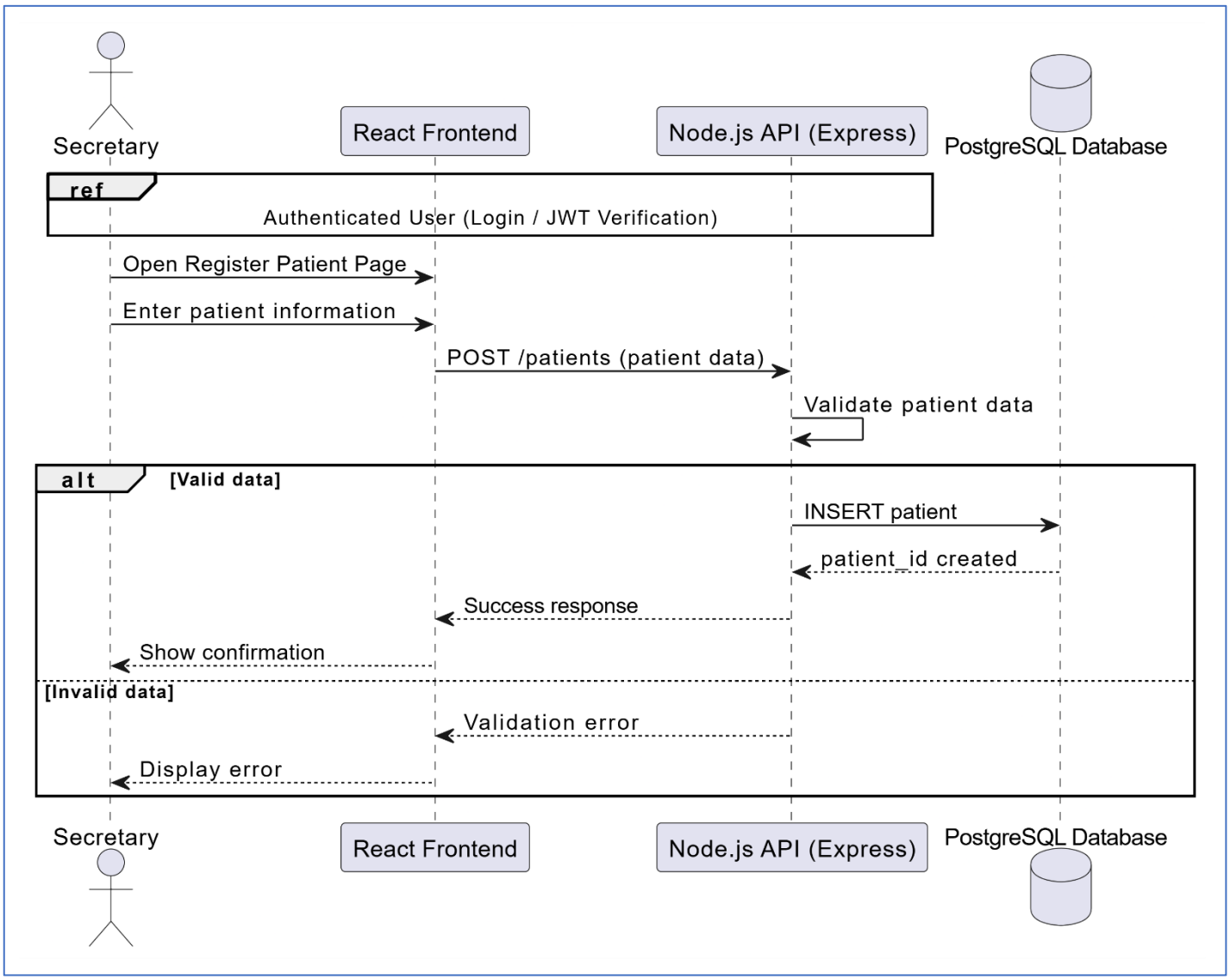


Figure 8: Create new patient Sequence diagram

Figure 8: This sequence diagram illustrates the process of registering a new patient within the system.

It shows the interaction between the secretary, the frontend application, the backend API, and the database during patient data validation and storage.

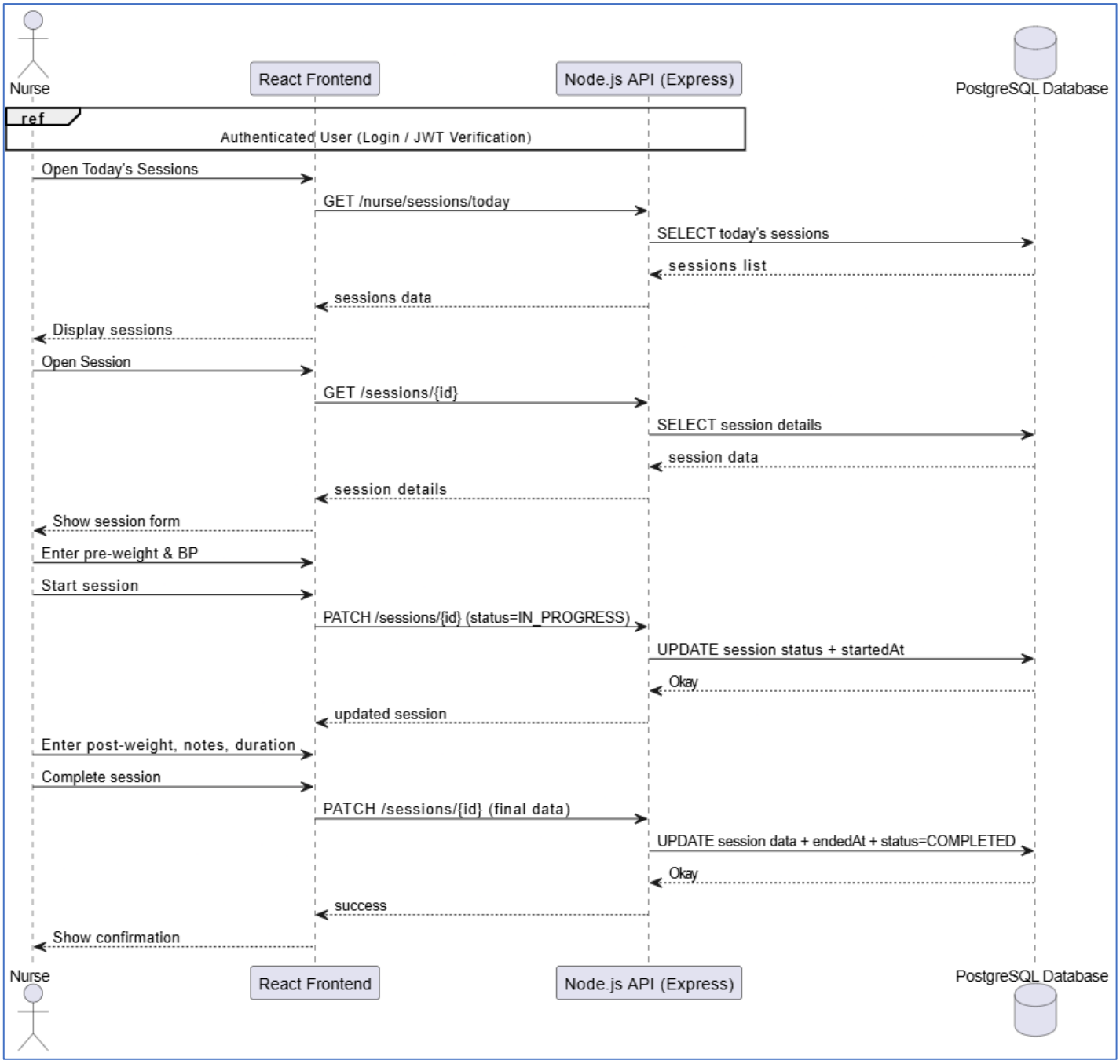


Figure 9: Nurse Manage the Dialysis Session Sequence diagram

Figure 9: This sequence diagram illustrates the workflow of managing a dialysis session by the nurse.

It shows the interactions between the frontend application, backend API, and database during session monitoring, status updates, and treatment data recording.

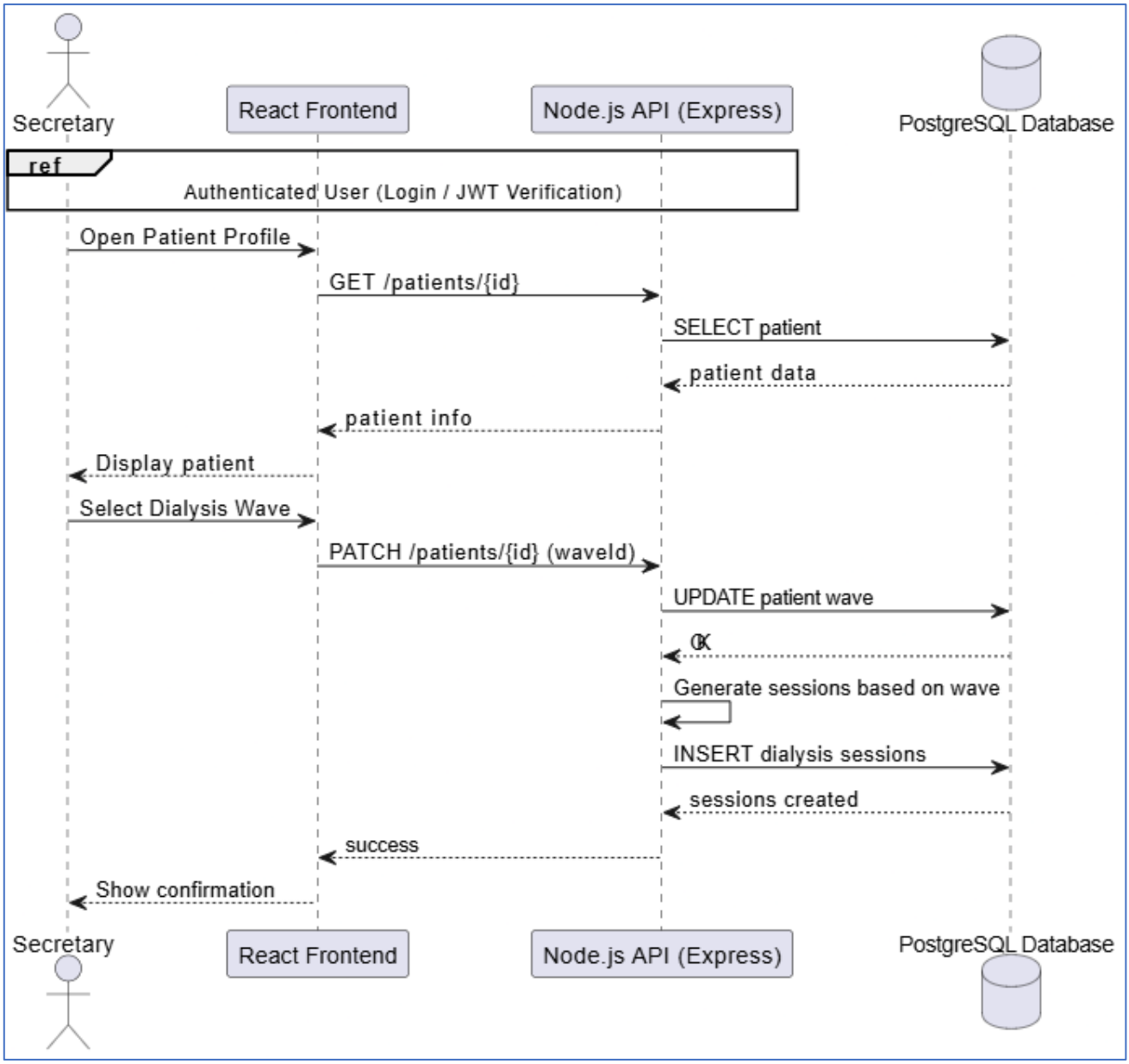


Figure 10: Assign Patient to Dialysis Wave

Figure 10: This sequence diagram illustrates the process of assigning a dialysis wave to a patient. It shows the interactions between the secretary, frontend application, backend API, and database during patient wave assignment and automatic dialysis session generation.

2.4.3 Class Diagrams:

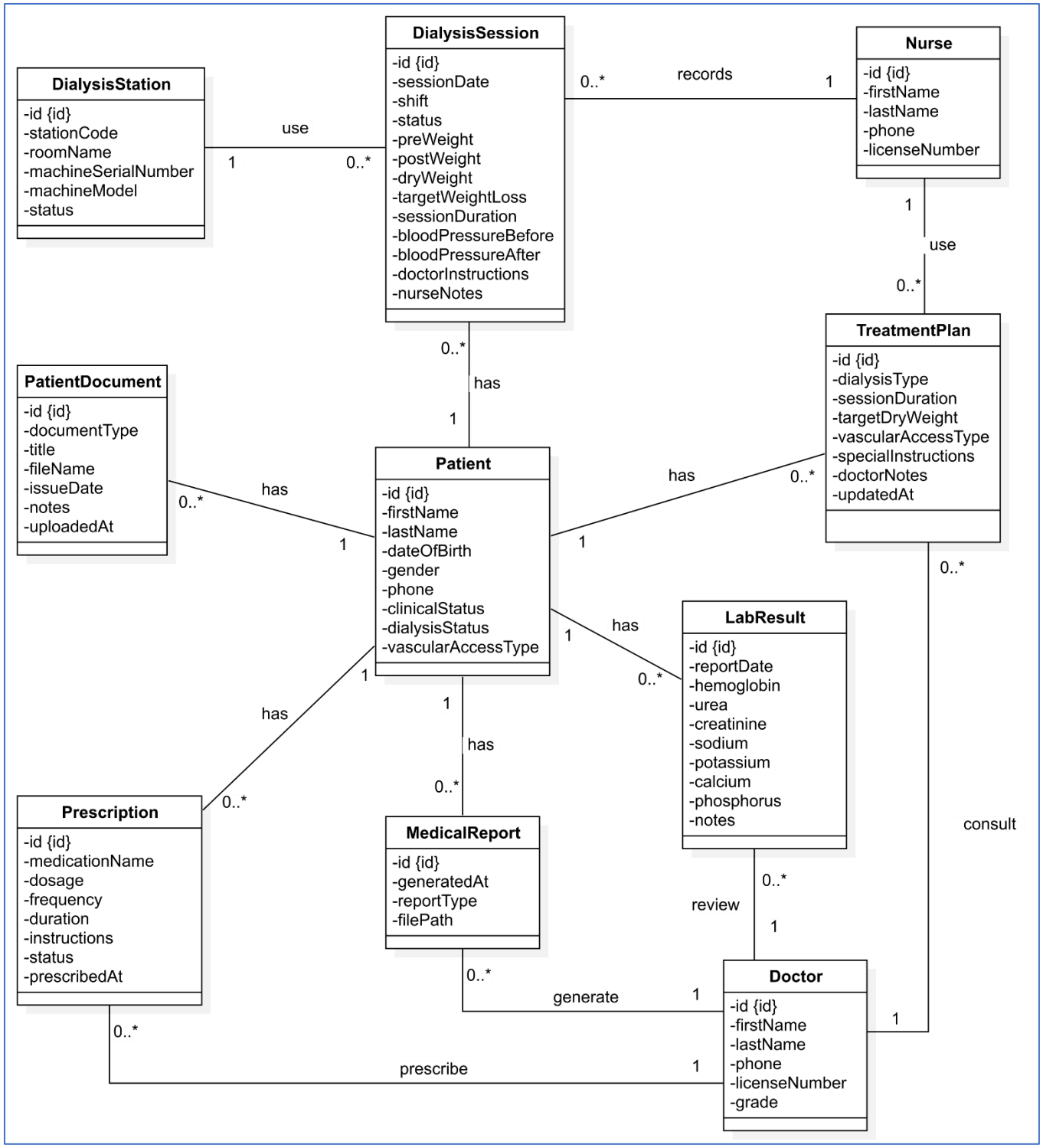


Figure 11: Hemodialysis Management Class Diagram

Figure 11: This class diagram illustrates the main entities involved in the medical and dialysis management module of the system and the relationships between them.

The diagram also shows the responsibilities of healthcare staff members within the system.

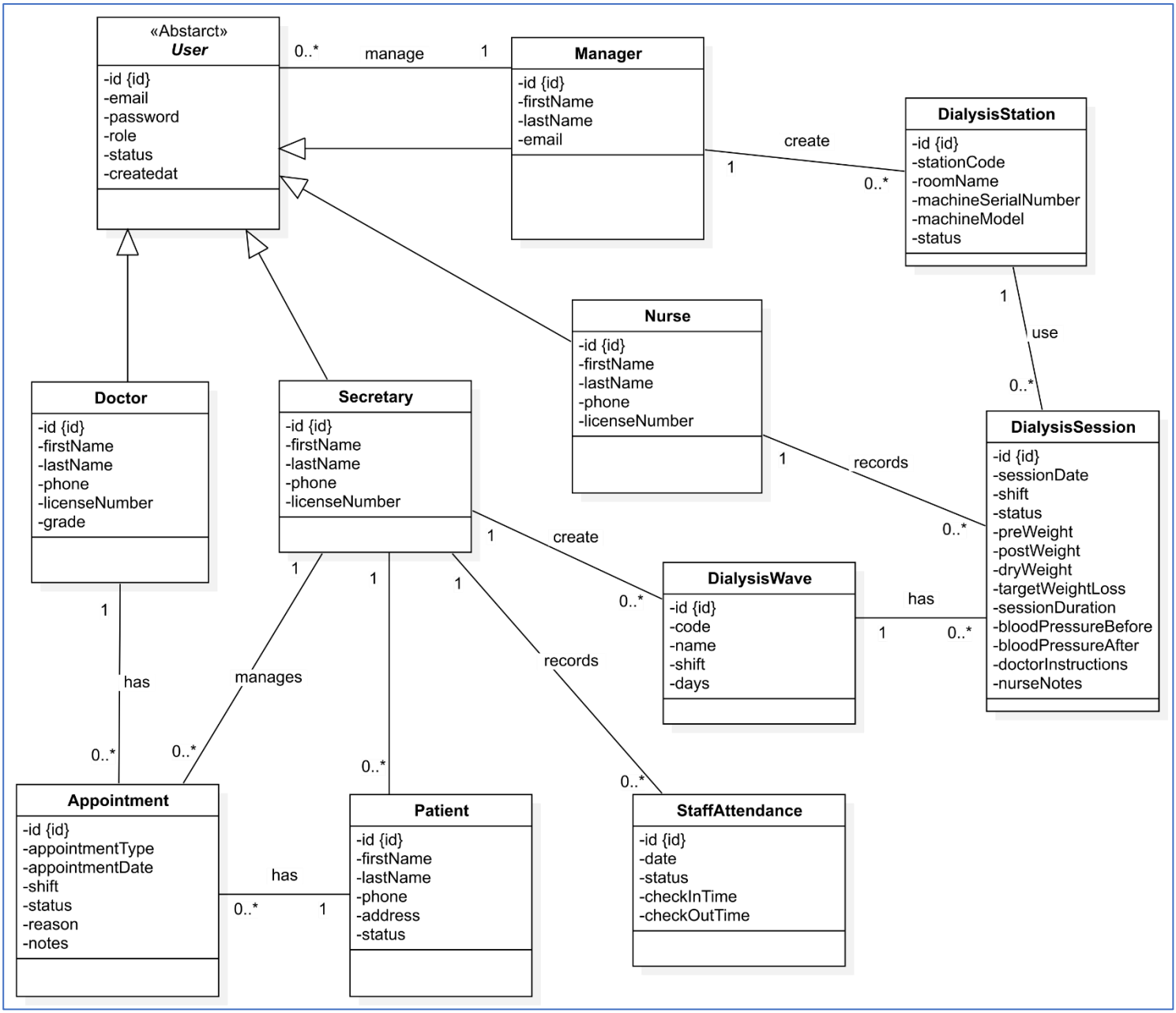


Figure 12: Administrative Management Class Diagram

Figure 12: This class diagram illustrates the main entities involved in the administrative and staff management module of the system and the relationships between them.
It shows how users are associated with different staff roles such as managers, doctors, nurses, and secretaries, while also presenting the relationships between patients, appointments, and dialysis stations.

The diagram also highlights the responsibilities of administrative staff within the clinic.

This structure supports efficient organization of administrative operations and staff management in the dialysis clinic.

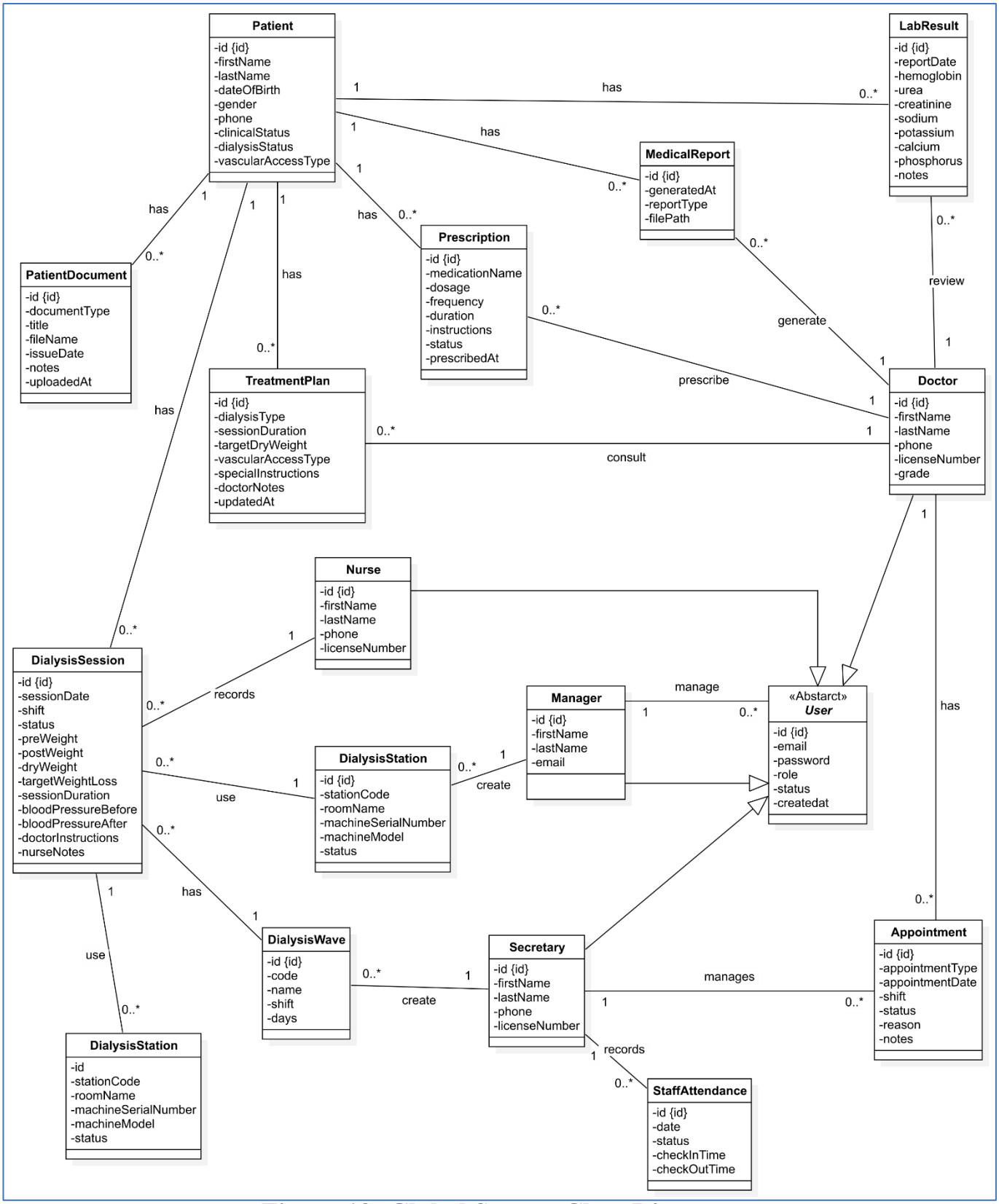


Figure 13: Global System Class Diagram

Figure 13: This class diagram presents an overall view of the system structure and the relationships between its main entities.
It illustrates the interactions between users, patients, medical management components, dialysis workflow entities, and administrative modules within the hemodialysis management system.

Chapter 3:
Realization and Implementation

3.1 Introduction:

After completing the analysis and design phase of the proposed system, the next step consists of transforming the conceptual models into a functional application. The realization phase represents one of the most important stages of the project lifecycle, as it allows the implementation of the system functionalities and validates the choices made during the conception phase.

This chapter presents the realization and implementation of the proposed hemodialysis clinic management system. It introduces the different technologies, development tools, and software environments used during the development process. In addition, this chapter presents the main interfaces of the application and explains the functionalities implemented for the different users of the system.

3.2 Technologies and Tools Used:

The realization of the proposed system required the use of several modern technologies and development tools. These technologies were selected according to the project requirements, system flexibility, performance, and ease of maintenance.

3.2.1 Front-end Technologies:

A-React.js:

React.js is a JavaScript library used for building dynamic and interactive user interfaces. It is based on reusable components, which facilitates the development and maintenance of modern web applications.

In this project, React.js was used to develop the graphical interfaces of the application, including dashboards, forms, scheduling interfaces, and patient management modules [5].

B-Tailwind CSS:

Tailwind CSS is a utility-first CSS framework used for designing responsive and modern user interfaces.

It was used to simplify interface styling and improve the visual appearance of the application while maintaining responsive behavior across different screen sizes [6].

3.2.2 Back-end Technologies:

A-Node.js:

Node.js is a JavaScript runtime environment that allows server-side execution of JavaScript applications. It is known for its performance, scalability, and asynchronous architecture.

Node.js was used in this project to implement the server-side logic and manage communication between the client application and the database [7].

B-Express.js:

Express.js is a lightweight web framework built on top of Node.js. It simplifies the creation of APIs and server-side applications.

In this project, Express.js was used to develop RESTful APIs responsible for handling authentication, data processing, user management, and communication with the database [8].

C- Prisma ORM:

Prisma ORM is a modern Object-Relational Mapping (ORM) tool that simplifies database access in Node.js applications. It provides a type-safe client, schema management, and database migration features.

In this project, Prisma ORM was used as the data access layer between the application and the databases. It handled database queries, entity relationships, and synchronization between the application models and the PostgreSQL and SQLite databases [9].

3.2.3 Database Technologies:

A-PostgreSQL

PostgreSQL is an open-source relational database management system known for its reliability, security, and performance.

The application uses PostgreSQL as the main database system for storing patient records, dialysis sessions, users, appointments, medical reports, and inventory information [10].

B-SQLite:

SQLite is a lightweight local database engine integrated into desktop applications.

It was used to support offline functionality by allowing temporary local storage of data when internet connectivity is unavailable [11].

3.2.4 Desktop Environment:

A-Electron.js:

Electron.js is a framework that enables the development of desktop applications using web technologies.

In this project, Electron.js was used to create the desktop version of the application and provide offline operational capability for dialysis clinics working in environments with unstable internet connectivity [12].

3.2.5 Development Tools:

A-Visual Studio Code:

Visual Studio Code is a source-code editor developed by Microsoft. It provides several features such as syntax highlighting, debugging tools, Git integration, and extension support.

It was used as the primary development environment during the implementation of the application [13].

B-Git & GitHub:

Git is a distributed version control system used to track modifications in source code during software development. It allows developers to manage different versions of a project efficiently and facilitates collaboration between team members [14].

GitHub is an online platform built around Git that provides source code hosting and project management functionalities [15].

In this project, Git and GitHub were used to manage source code versions, track project modifications, and maintain backups of the application throughout the development process.

C-Postman:

Postman is an API development and testing platform used for sending HTTP requests and analyzing server responses.

In this project, Postman was used to test REST APIs, verify data exchange between the front-end and back-end, and validate authentication and system functionalities [16].

3.2.6 Modeling Tools:

Draw.io:

Draw.io is an online diagramming tool used for creating different types of system diagrams and visual representations. It provides a simple and intuitive interface for designing UML diagrams and software architecture models.

In this project, Draw.io was used to create the class diagrams and sequence diagrams presented during the analysis and conception phases [17].

Visual Paradigm Online:

Visual Paradigm Online is a web-based modeling platform specialized in UML modeling and software design. It supports several types of diagrams used in software engineering.

In this project, Visual Paradigm Online was used to create the use case diagrams representing the interactions between the different actors and the proposed system [18].

3.3 System Architecture:

The proposed system adopts a hybrid architecture composed of a web application and a desktop application. This architecture was designed to ensure system availability and continuous operation in different working environments.

The web version of the application communicates with a hosted backend server connected to a centralized PostgreSQL database hosted on NeonDB [19]. This environment allows remote access to the platform through the internet.

In parallel, the desktop application operates through a local backend server connected to a local SQLite database. This configuration allows the application to continue functioning even in the absence of internet connectivity.

To maintain data consistency between the local and hosted environments, a synchronization mechanism is implemented. When internet connectivity becomes available, locally stored data is synchronized automatically with the hosted server and the central database.

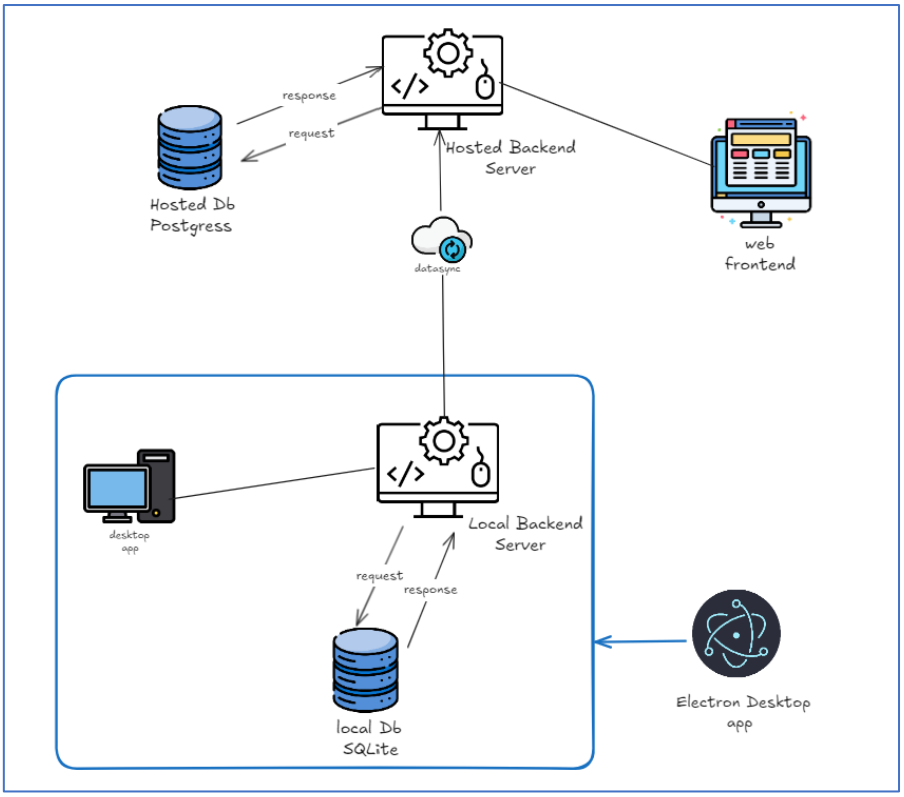


Figure 14: System Architecture design

Figure 14: presents the global architecture of the proposed system and the synchronization mechanism between the different application components.

3.3 Platform interfaces:

This section presents the main interfaces developed for the hemodialysis care platform. These interfaces were designed to provide an intuitive and user-friendly experience for medical staff and administrators. The following screenshots illustrate the different functional modules implemented within the system.

3.3.1 Authentication Interface:

The authentication interface enables users to securely access the platform using their credentials. It verifies user identity and redirects authenticated users to their corresponding dashboards according to their roles.

❖ **Login page:**

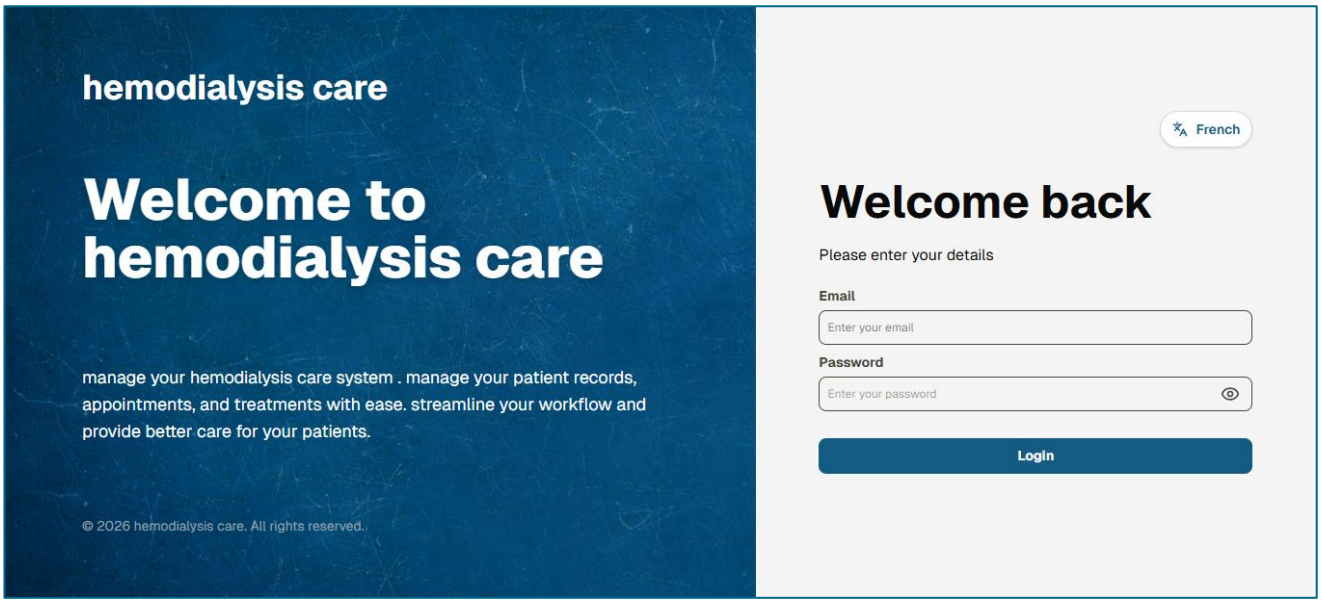


Figure 15: Login page

Figure 15: This figure illustrates the login interface of the platform, where users authenticate using their credentials to access the system securely.

3.3.2 Manager Interfaces:

❖ Manager Dashboard:

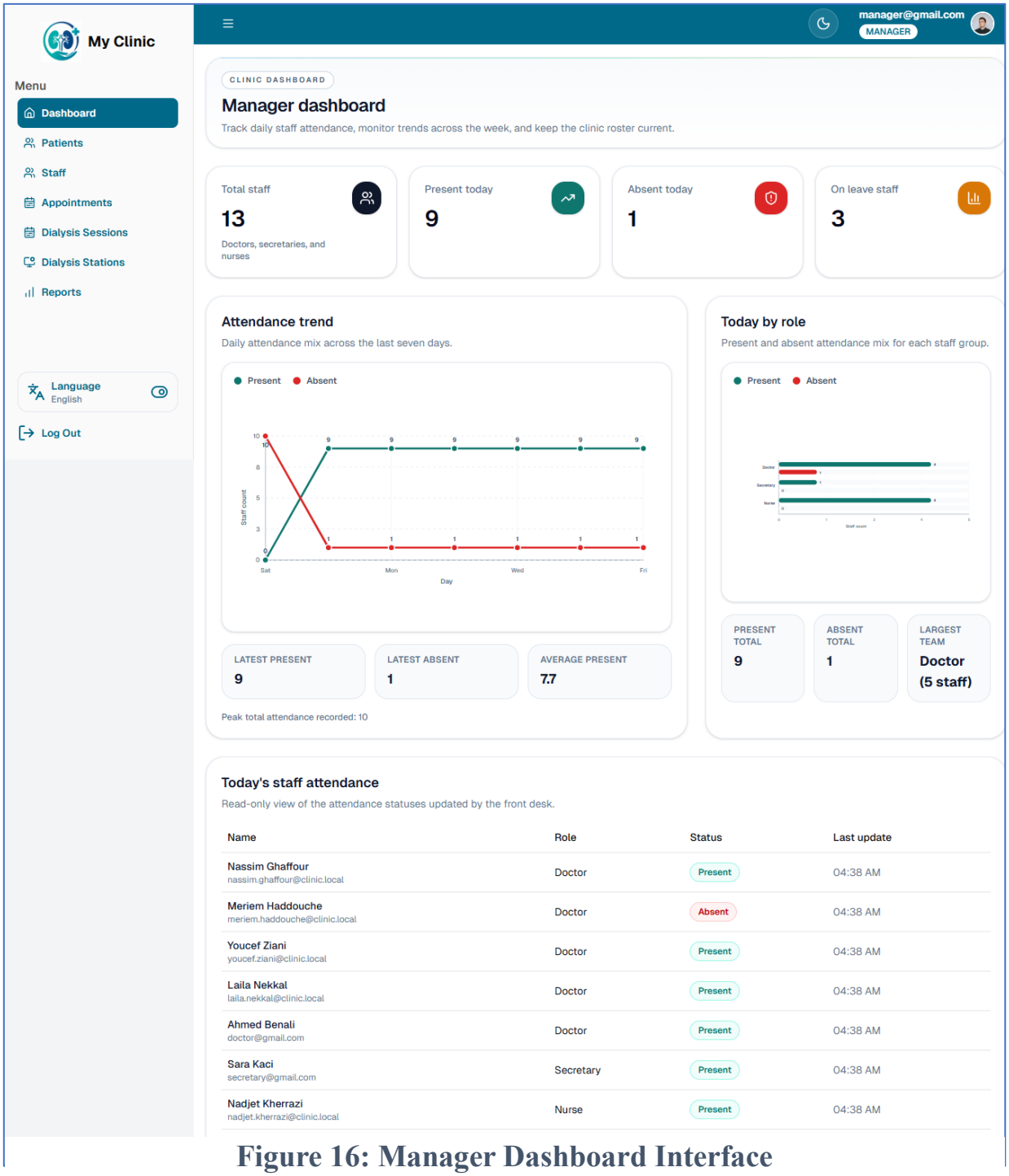


Figure 16: Manager Dashboard Interface

Figure 16: This interface provides managers with an overview of the clinic's daily operations and staff attendance.
It displays attendance statistics, staff status summaries, attendance trends, and role-based analytics, allowing a proper staff tracking and clinic management.

❖ Patient Management Interface:

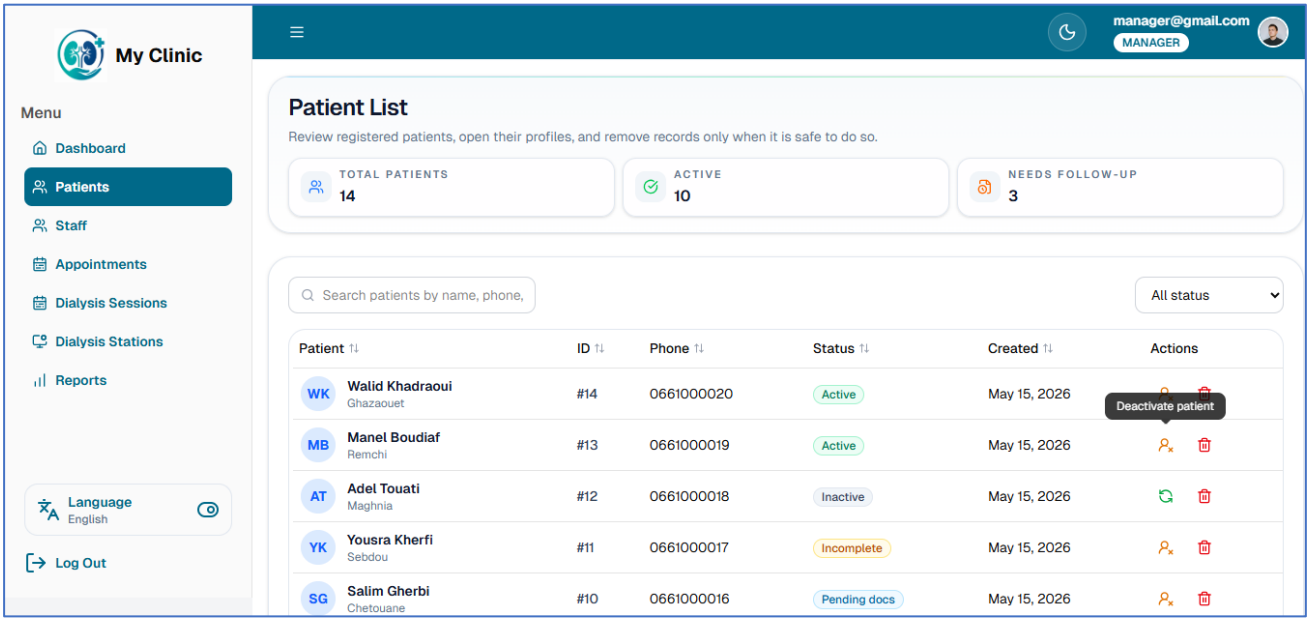


Figure 17: Manager Patient Management Interface

Figure 17: This interface enables managers to monitor patient records within the platform. It provides functionalities for searching patients, viewing patient information, tracking patient status, and performing administrative actions such as updating or deleting records when necessary.

❖ patient Management Interface:

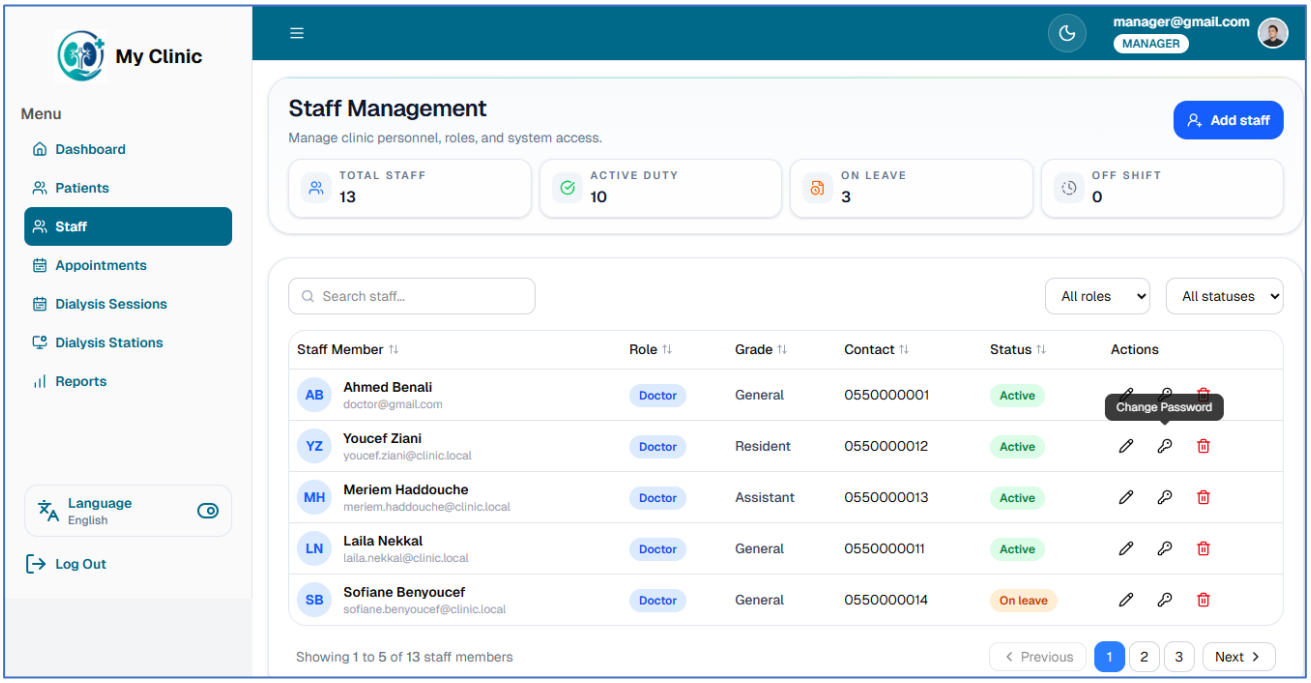


Figure 18: Staff Management Interface

Figure 18: This interface allows managers to manage clinic staff members and adding new staff members,
It provides functionalities for searching staff records, performing administrative actions such as updating, changing passwords, or deleting staff accounts.

❖ Add Staff Member Interface:

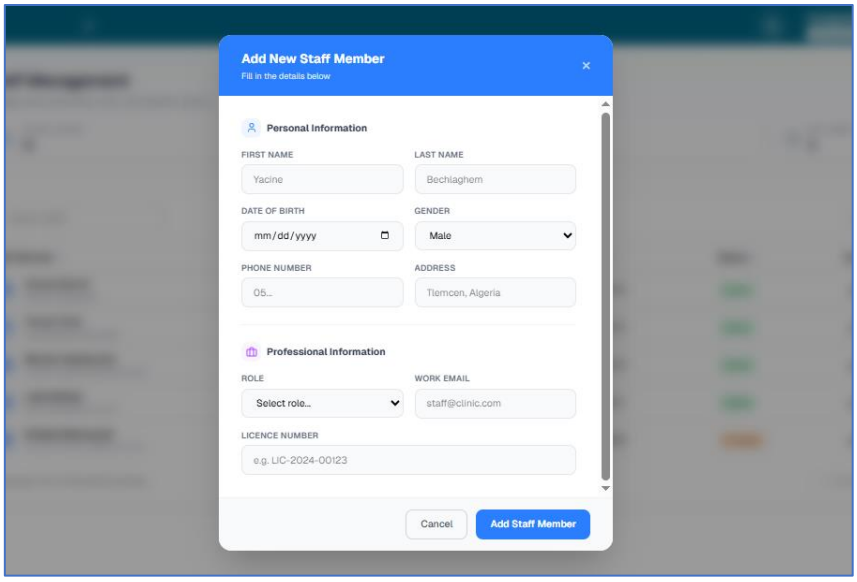


Figure 19: Add Staff Member Interface

Figure 19: This interface enables managers to register new staff members within the platform by entering their personal and professional information.
It includes fields for identity details, contact information, role assignment, and professional credentials required for staff management.

❖ Dialysis Stations Management Interface:

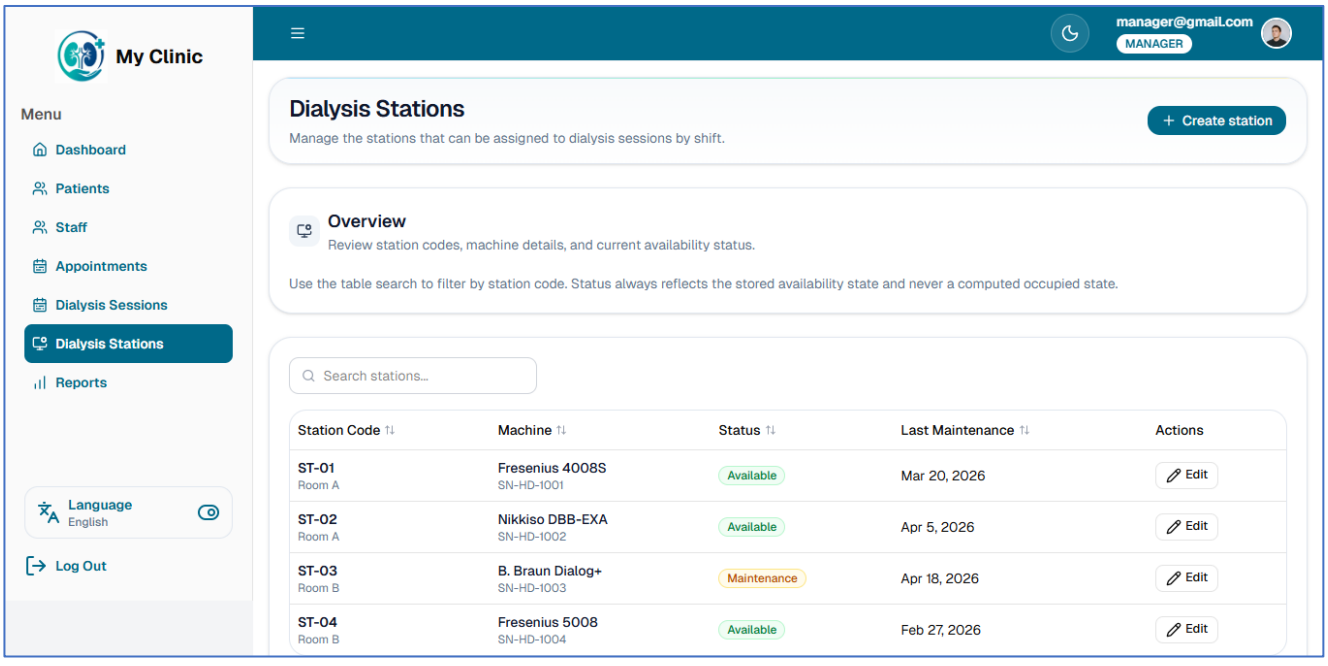


Figure 20: Dialysis Stations Management Interface

Figure 20: This interface allows managers to monitor and manage the dialysis stations.
It provides information about station codes, assigned machines, availability status, and maintenance schedules,
facilitating the organization and allocation of stations during dialysis sessions.

❖ Manager Reports Interface:

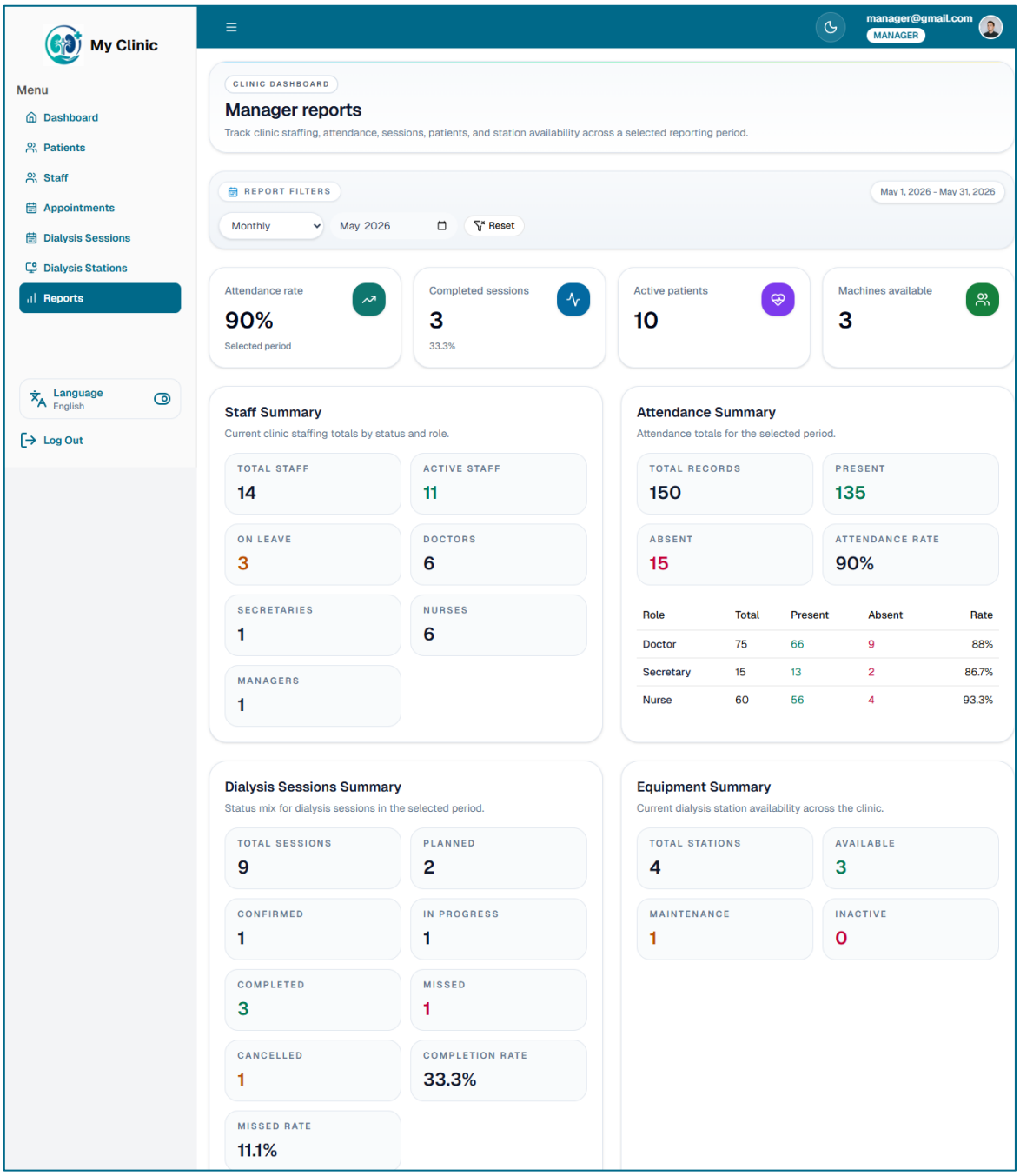


Figure 21: Manager Reports Interface

Figure 21: This interface provides managers with analytical reports and statistical summaries related to clinic operations.

It displays information about staff attendance, dialysis sessions, active patients, and equipment availability,

allowing managers to monitor performance indicators and evaluate the overall activity of the clinic during a selected reporting period.

3.3.3 Secretary Interfaces:

❖ Secretary Dashboard:

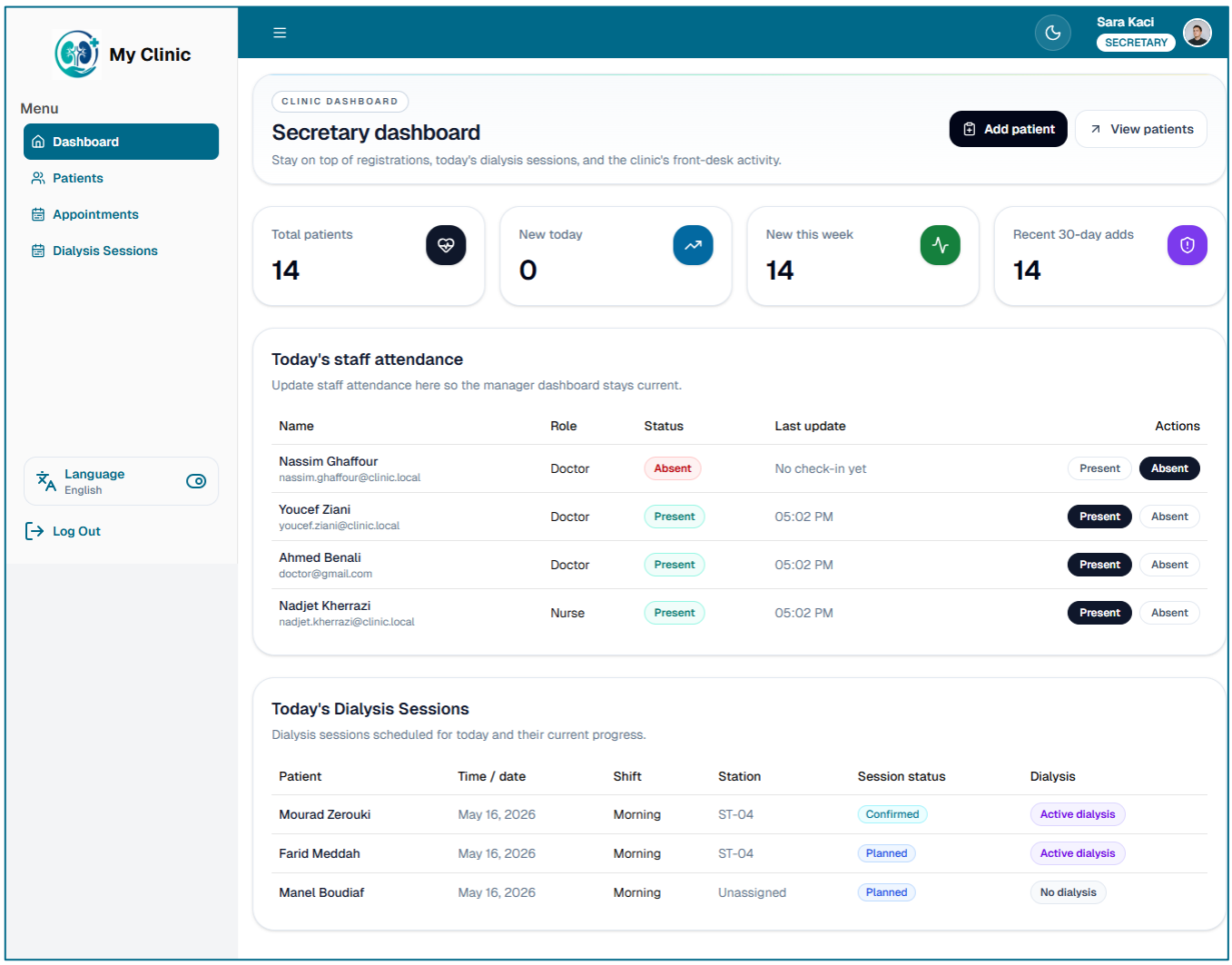


Figure 22: Secretary Dashboard Interface

Figure 22: This interface provides secretaries with an overview of daily clinic activities. It displays patient statistics, staff attendance, and scheduled dialysis sessions, enabling efficient management of patient registration and daily front-desk operations.

❖ Appointment Management:

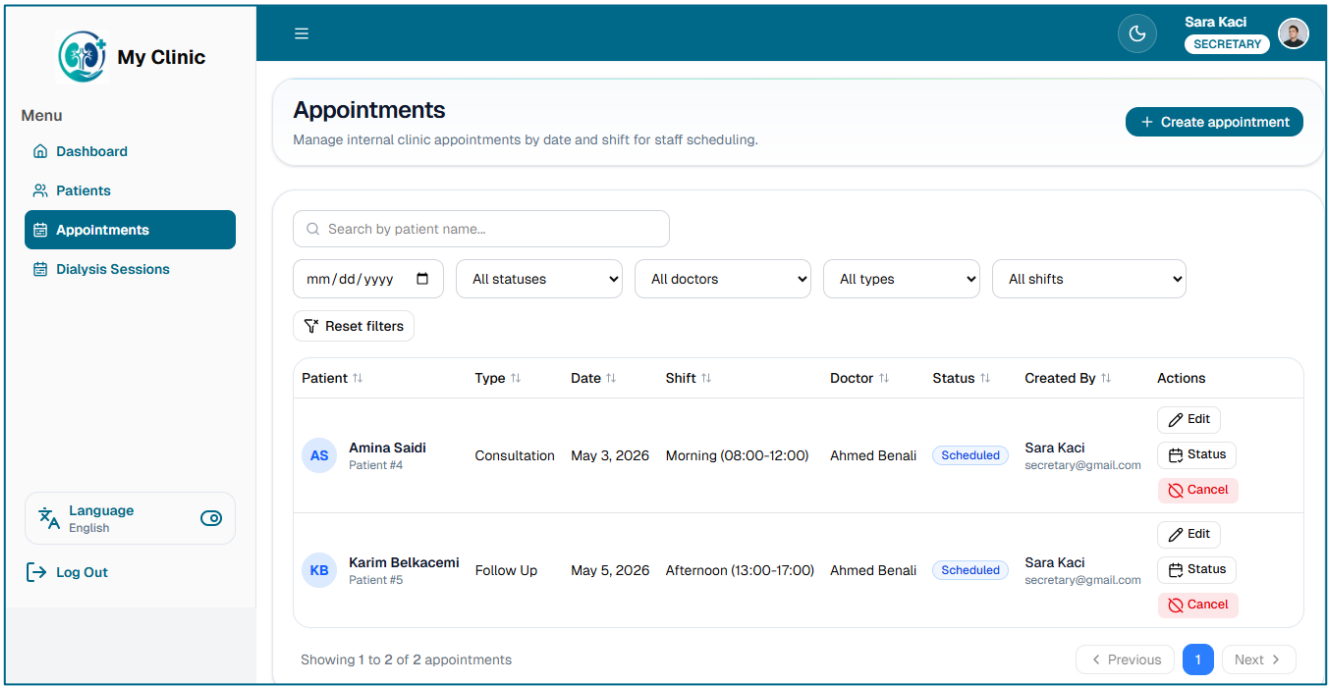


Figure 23: Appointment Management Interface

Figure 23: This interface allows secretaries to manage patient appointments within the clinic. It provides functionalities for scheduling consultations and follow-up appointments, filtering appointments by different criteria,

❖ Dialysis Sessions Management:

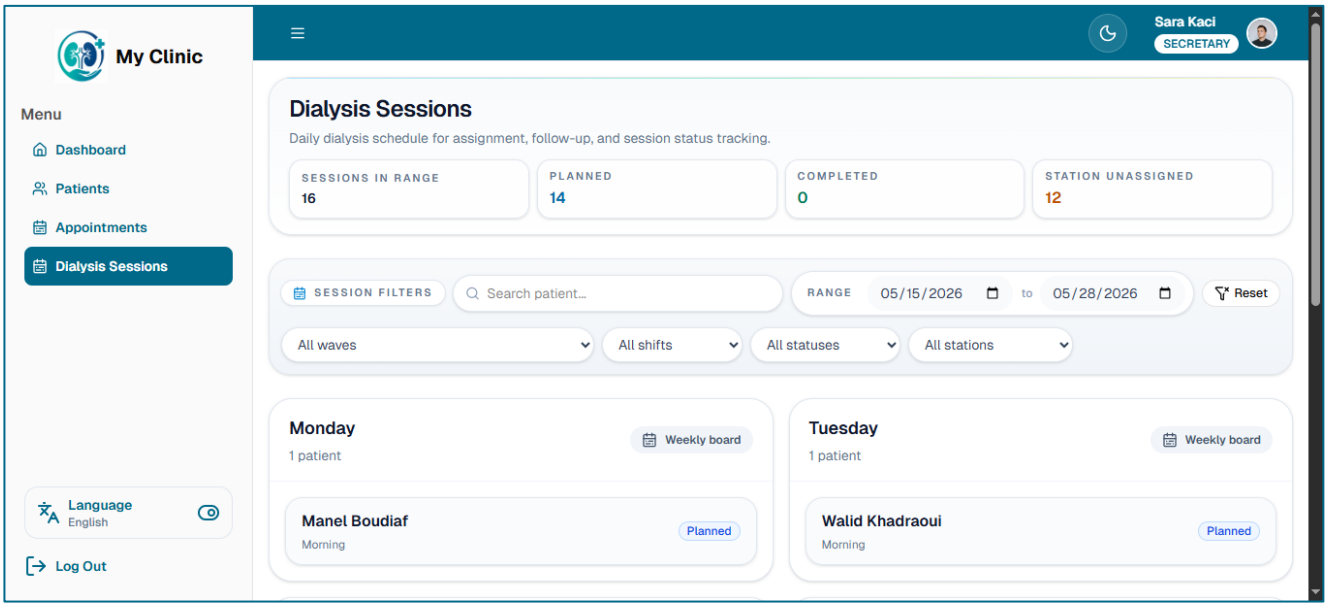


Figure 24: Dialysis Sessions Management Interface

Figure 24: This interface enables secretaries to monitor dialysis sessions scheduled for patients. It provides tools for filtering sessions by date, shift, status, and station assignment, while also displaying the weekly dialysis schedule and tracking the progress and status of each session.

❖ Patient Administrative Information Interface:

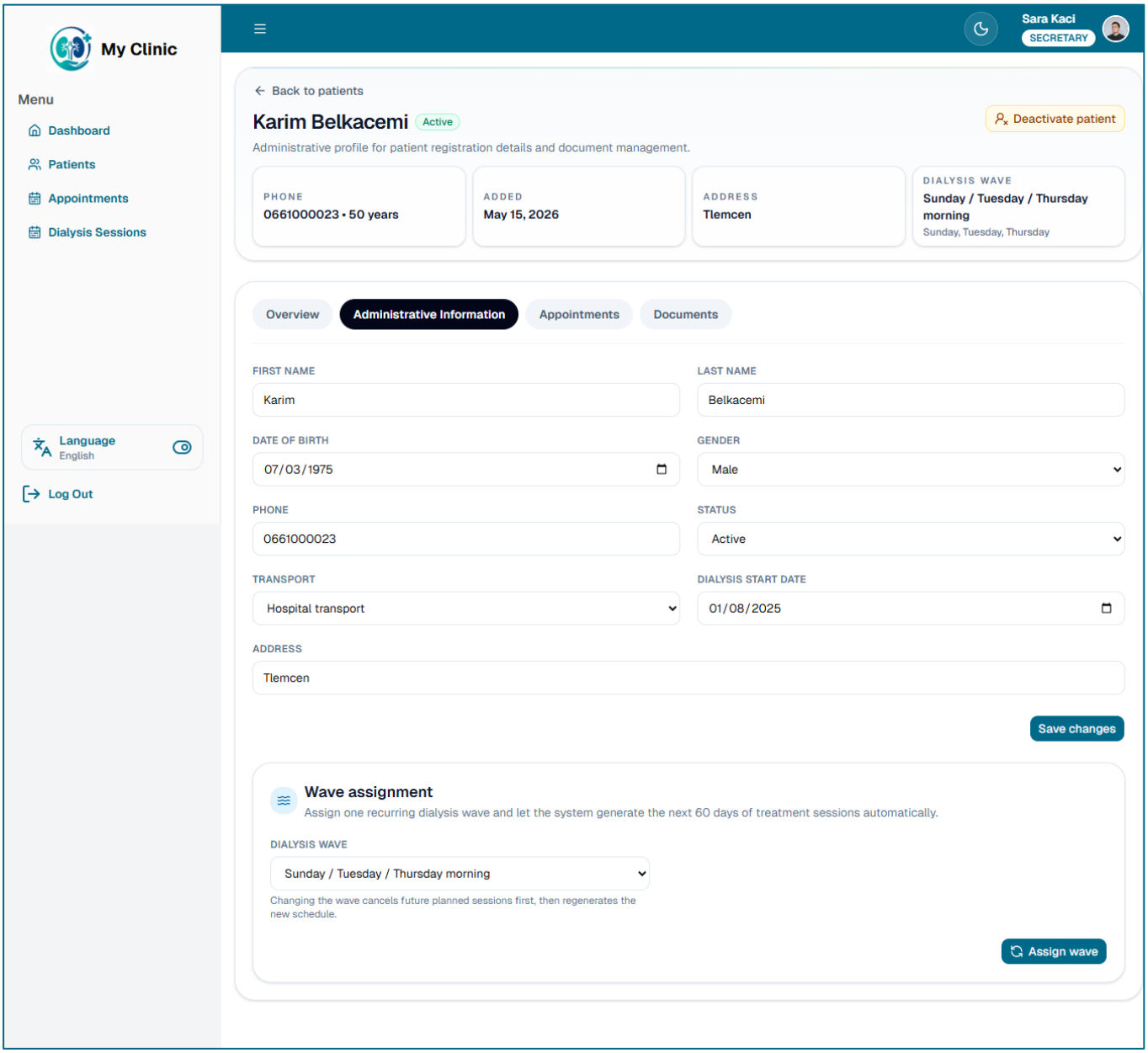
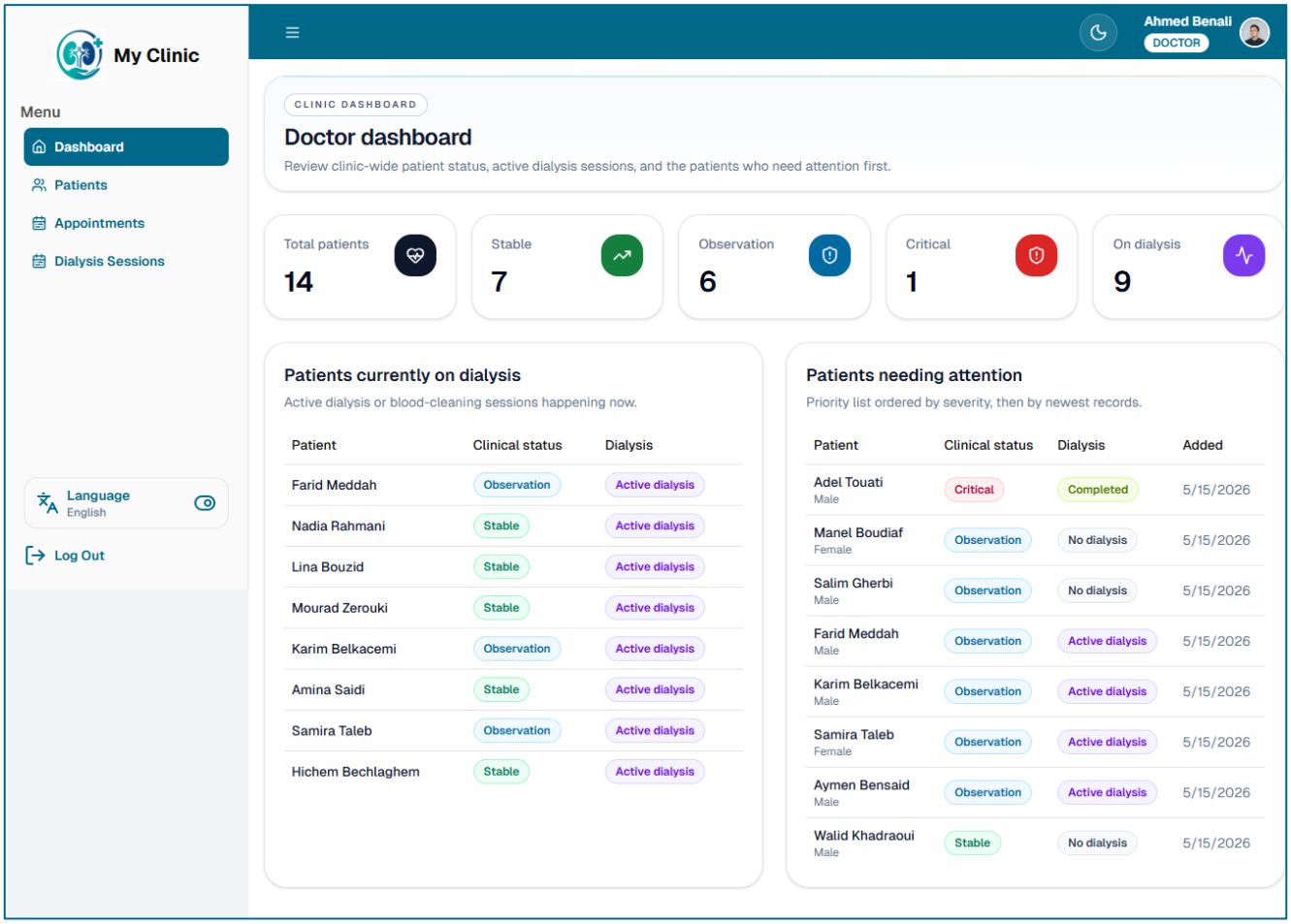


Figure 25: Patient Administrative Information Interface

Figure 25: This interface allows secretaries to manage and update patient administrative and personal information within the platform.

It includes patient identity details, contact information, dialysis schedule assignment, and treatment-related administrative data.

3.3.4 Doctor Interfaces:



❖ **Doctor Dashboard:**

Figure 26: Doctor Dashboard

Figure 26: This interface provides doctors with an overview of patient conditions and active dialysis sessions within the clinic.

It displays patient clinical status, ongoing dialysis treatments, and patients requiring immediate medical attention,

helping doctors monitor and prioritize patient care efficiently.

❖ Dialysis Session History:

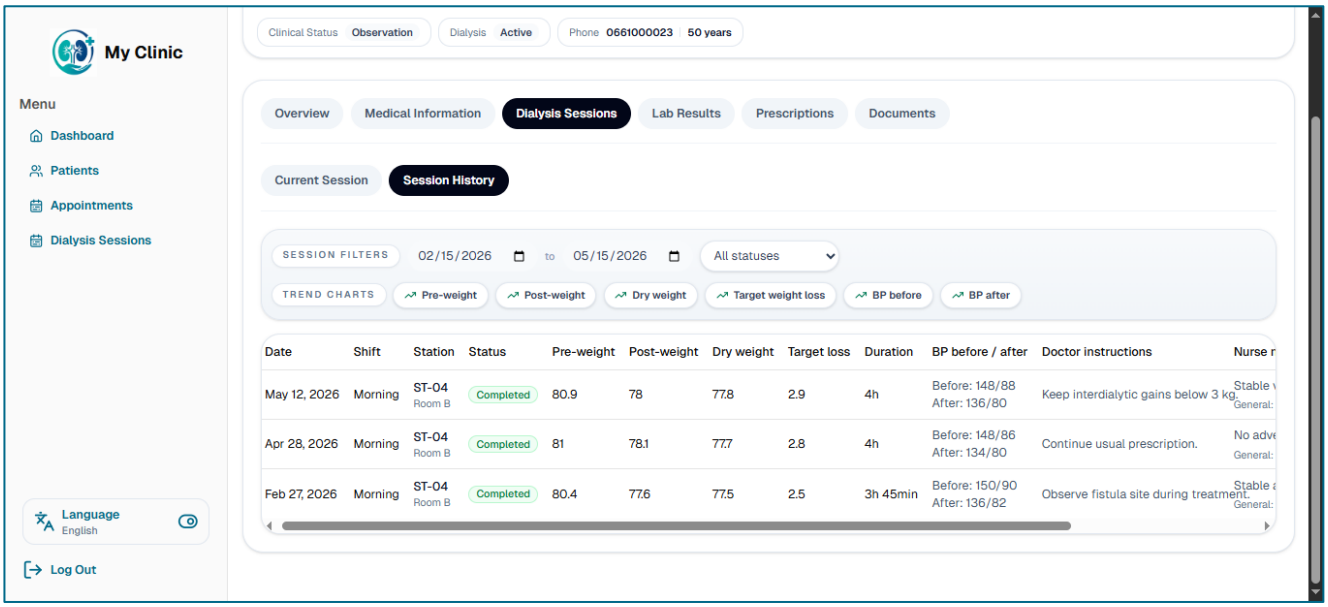


Figure 27: Dialysis Session History Interface

Figure 27: This interface allows doctors to review the history and progress of patient dialysis sessions.
It displays detailed session information including treatment status, weight measurements, blood pressure monitoring,
session duration, and medical instructions for patient follow-up and clinical evaluation.

❖ Laboratory Results chart:

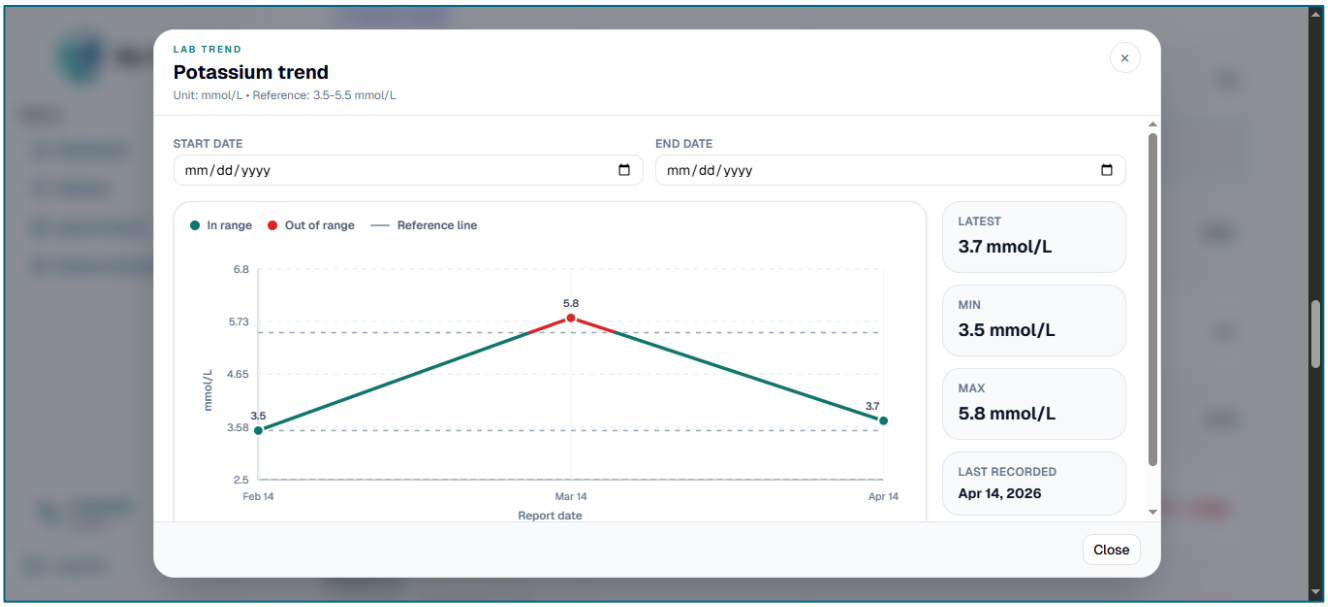


Figure 28: Laboratory Results Trend Interface

Figure 28: This interface allows doctors to monitor and analyze patient laboratory result trends over time.

❖ Laboratory Results Management:

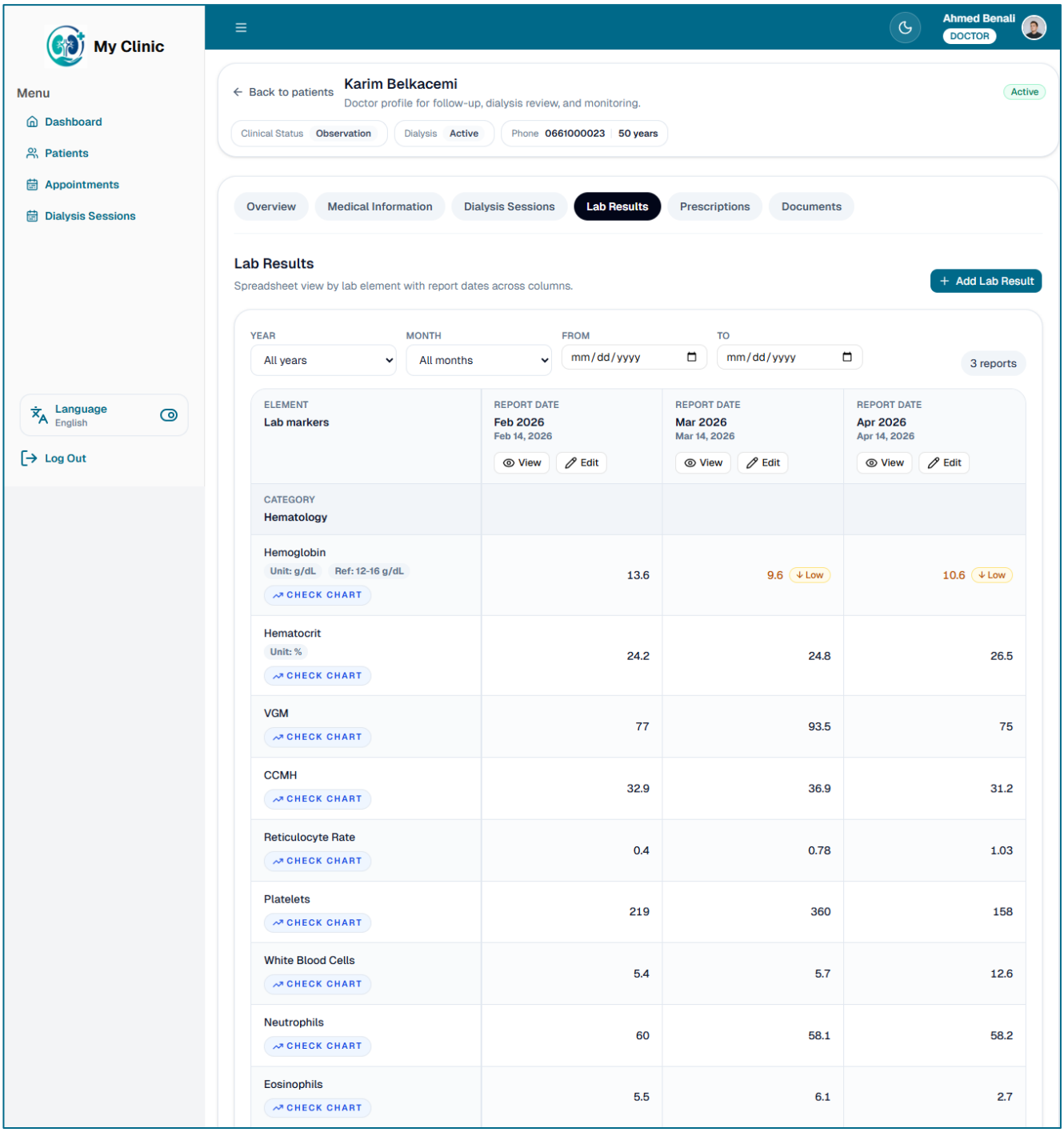


Figure 29: Laboratory Results Management

Figure 29: This interface enables doctors to manage and review patient laboratory results within the platform.
It displays medical analysis records across multiple report dates and helps doctors monitor patient health indicators and treatment progress.

3.3.5 Nurse Interface:

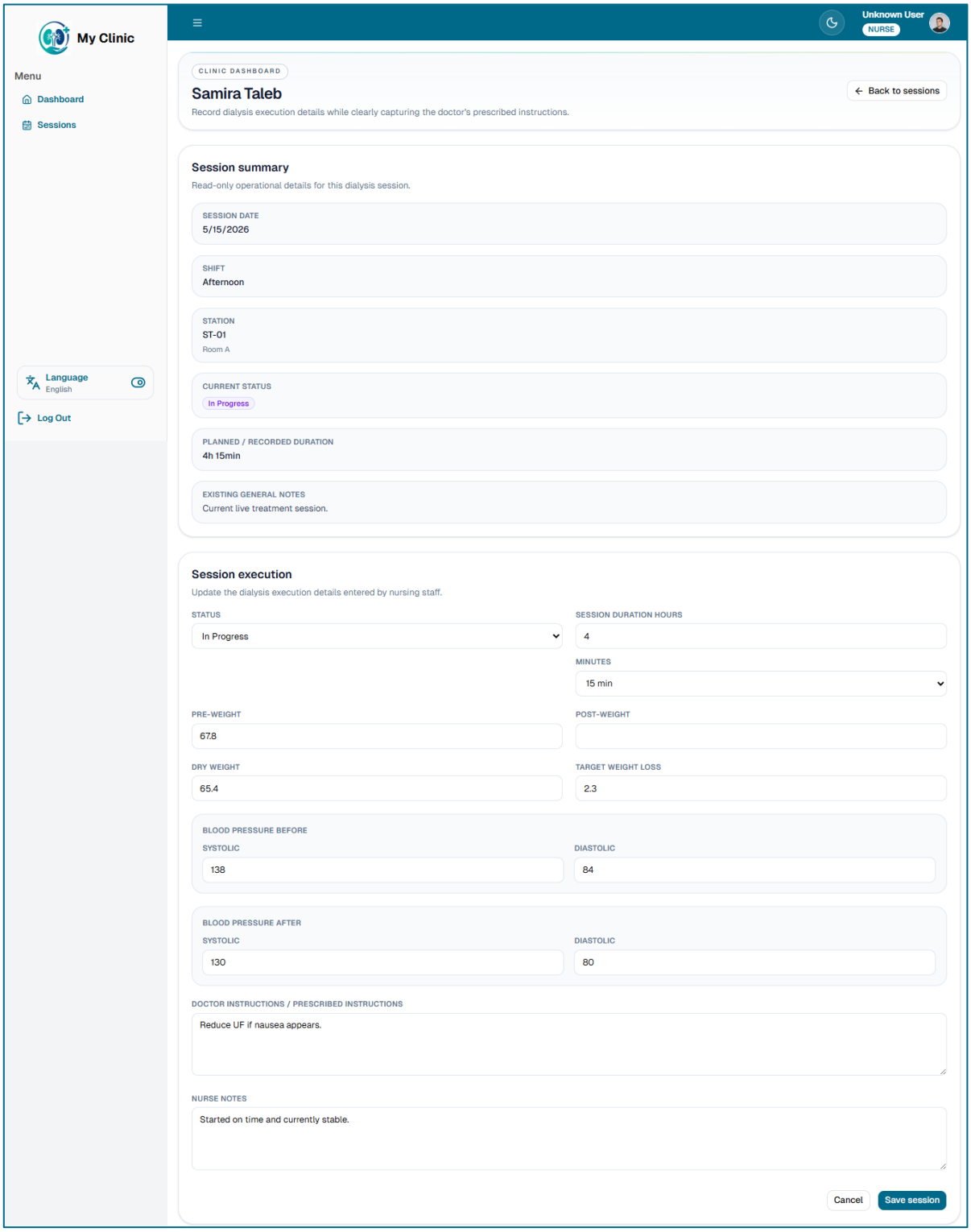


Figure 30: Dialysis Session Execution Interface

Figure 30: This interface allows nurses to record and monitor dialysis session execution details for patients.
It includes treatment information such as session duration, weight measurements, blood pressure monitoring, and nursing observations during the dialysis process.

3.4 Conclusion:

In this chapter, we presented the implementation and realization phase of the hemodialysis management system.
We described the different technologies, tools, and frameworks used for the development of the application, as well as the adopted system architecture and database structure.

We also presented the main interfaces developed for the different users of the platform, including managers, secretaries, doctors, and nurses.
In addition, several UML diagrams and sequence diagrams were introduced to explain the relationships between system components and the workflows of the main functionalities such as patient management, dialysis sessions, appointments, laboratory results, and medical monitoring.

This chapter represents the practical and technical realization of our project, where the analysis and design phases were transformed into a functional and interactive application.

General Conclusion:

The proposed hemodialysis management system provides a practical and reliable solution for hemodialysis clinics in Algeria.
with this platform, the clinic staff can manage both patient administrative records and medical records, organize dialysis sessions, also simplifying the medical follow-up for doctors and daily administrative operations within the system.

The application combines both web and desktop environments in order to provide flexibility and eliminate the risk of bad connectivity or data lost. In addition, the integration of an offline synchronization mechanism allows the system to be available at all times and continue functioning even when internet connectivity is unavailable, which improves reliability and accessibility in medical environments.

Several future improvements are still be considered, such as the development of a mobile application to notify patient or for nurse for ease of work integrate dialysis machines with desktop app to manager session in real time, stock management (filters, needles,), advanced reporting and statistical analysis, and the use of emerging technologies such as artificial intelligence to improve medical monitoring and decision support.

Webography:

[1] Nipro Corporation. Nipro NephroFlow – Dialysis Information Management Solution. Available at: https://www.medicalexpo.com/prod/nipro-middle-east-fze/product-4588274-1173289.html Accessed: June 21, 2026.

[2] Renal Works. RenalGenie – Dialysis Management Software. Available at: https://renalworks.com/renalgenie-dialysis-management-software/ Accessed: June 21, 2026.

[3] Clinicea. Clinicea Dialysis EMR – Dialysis Centre Management Software. Available at: https://clinicea.com/dialysis-centre Accessed: June 21, 2026.

[4] DiMS. DiMS – Dialysis Management System Features. Available at: https://dims.my/features Accessed: June 21, 2026.

[5] Meta Platforms, Inc. React – A JavaScript Library for Building User Interfaces. Available at: https://react.dev Accessed: June 21, 2026.

[6] Tailwind Labs. Tailwind CSS Documentation. Available at: https://tailwindcss.com Accessed: June 21, 2026.

[7] OpenJS Foundation. Node.js – JavaScript Runtime Environment.Available at: https://nodejs.org

Accessed: June 21, 2026.

[8] Express.js. Express Web Framework Documentation. Available at: https://expressjs.com

Accessed: June 21, 2026.

[9] Prisma. Prisma Documentation. Available at: https://www.prisma.io/docs

Accessed: June 21, 2026.

[10] PostgreSQL Global Development Group. PostgreSQL Documentation. Available at: https://www.postgresql.org/docs Accessed: June 21, 2026.

[11] SQLite Consortium. SQLite Documentation. Available at: https://www.sqlite.org/docs.html

Accessed: June 21, 2026.

[12] Electron Foundation. Electron Documentation. Available at https://www.electronjs.org/docs/latest

Accessed: June 21, 2026.

[13] Microsoft Corporation. Visual Studio Code – Code Editing Redefined. Available at: https://code.visualstudio.com Accessed: June 21, 2026.

[14] Git Project. Git Documentation. Available at: https://git-scm.com/doc Accessed: June 21, 2026.

[15] GitHub, Inc. GitHub Documentation. Available at: https://docs.github.com Accessed: June 21, 2026.

[16] Postman. Postman API Platform Documentation. Available at:https://learning.postman.com/docs/

Accessed: June 21, 2026.

[17] diagrams.net. Draw.io Diagramming Tool. Available at: https://www.diagrams.net

Accessed: June 21, 2026.

[18] Visual Paradigm International. Visual Paradigm Online. Available at: https://online.visual-paradigm.com Accessed: June 21, 2026.

[19] Neon, Inc. Neon – Serverless PostgreSQL Database Platform. Available at: https://neon.com

Accessed: June 21, 2026.

[20] Meguenni K, et al. Epidemiology of Chronic Kidney Disease Stage V Treated by Dialysis in the Maghreb. Clinical Epidemiology and Global Health, Vol. 12, 2021. Available at: https://www.ceghonline.com/article/S2213-3984(21)00116-0/fulltext. Accessed: June 21, 2026.

[21] Mayo Clinic. *Hemodialysis*. Available at: https://www.mayoclinic.org/tests-procedures/hemodialysis/about/pac-20384824. Accessed: June 21, 2026.

[22] Ioffe S., and Szegedy C. *Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift*. arXiv preprint arXiv:1502.03167, 2015. Available at: https://arxiv.org/pdf/1502.03167.pdf. Accessed: June 21, 2026.

REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique

Université Abou Bekr Belkaid Tlemcen

Business Model Canvas

BMC

Faculty : Sciences

Département : computer science

Project name: Design And Implementation of a Management Solution for a Hemodialysis Clinic

Supervisor: supervisor Mr.BENAMAR ABDELKRIM

Student: BECHLAGHEM YACINE ABDEL-ILLAH

Academic year: 2025/2026

1-Proposition de valeur (Value Proposition)القيمة المقترحة

a. What problems do we solve for our customers?

ما هي المشاكل التي نحلها لعملائنا ؟

- Fragmented medical and administrative data.
- Reliance on paper-based records.
- Difficulty accessing patient information quickly.
- Inefficient scheduling of dialysis sessions.
- Limited coordination between healthcare professionals.
- Risk of data loss and information inconsistency.
- Service interruptions caused by unstable internet connectivity

b. What customer needs do our products or services satisfy?

ما هي الاحتياجات التي يلبيها منتجاتنا أو خدماتنا لعملائنا؟

- Need for centralized patient information management.
- Need for accurate patient monitoring and follow-up.
- Need for efficient dialysis session scheduling.
- Need for secure storage of medical records.
- Need for collaboration between doctors, nurses, and administrative staff.
- Need for access to data in both online and offline environments.
- Need for reliable reports and operational statistics.

c. How is our offer different from competitors?

في ماذا تختلف عروضنا عن تلك التي يقدمها منافسونا؟

- Designed specifically for hemodialysis clinics.
- Integrates medical and administrative management in one platform.
- Provides dedicated interfaces for doctors, nurses, secretaries, and managers.
- Supports both web and desktop environments.
- Allows offline operation through local databases.
- Includes data synchronization between local and hosted databases.

d. What is our unique value proposition?

ما هو العرض الفريد للقيمة لدينا؟

- A comprehensive hemodialysis clinic management system that centralizes medical and administrative operations while ensuring continuous access to data through hybrid online and offline functionality.

2-Customer Segments انواع العملاء :

a. Who are our main customers?

من هم العملاء او الزبائن الرئيسيون ؟

- Private dialysis clinics.
- Public dialysis centers.
- Hospitals with dialysis units.
- Nephrology departments.

b. What different customer segments do we target?

ما هي الفئات المختلفة من العملاء التي تستهدفها؟

- Healthcare professionals (doctors and nurses).
- Administrative staff (secretaries and managers).
- Dialysis centers and clinics.
- Hospitals with nephrology departments.

c. What are the specific needs of each customer segment?

ما هي الاحتياجات الخاصة لكل فئة من العملاء؟

Doctors

- Patient monitoring.
- Medical reports.
- Prescriptions and treatment plans.

Nurses

- Dialysis session recording.
- Patient follow-up.
- Clinical observations.

Administrative Staff

- Appointment scheduling.
- Patient registration.
- Staff management.

Dialysis Centers

- Operational efficiency.
- Resource management.
- Centralized information.

d. How can we categorize our customers into distinct groups?

كيف يمكن تصنيف عملائنا الى مجموعات مختلفة؟

By role

- Doctors.
- Nurses.
- Secretaries.
- Managers.

By institution type

- Private clinics.
- Public dialysis centers.
- Hospitals.

By usage objective

- Medical follow-up.
- Administrative management.
- Operational monitoring.

3-Customer Relationships علاقة مع العملاء :

a. What type of relationship does each customer segment expect from us?

اي نوع من العلاقة يتوقعه كل فئة من العملاء منا؟

Doctors and Nurses

- Reliable technical support.
- Regular system updates.
- Secure and continuous access to patient information.

Administrative Staff

- Easy-to-use interfaces.
- User training and guidance.
- Fast issue resolution.

Dialysis Centers and Hospitals

- Continuous maintenance.
- Deployment assistance.
- Long-term technical support.

b. How do we currently maintain relationships with our customers?

كيف نحافظ حاليًا على العلاقات مع عملائنا؟

- Platform demonstrations and presentations.
- User training sessions.
- Technical support via phone, email, or remote assistance.
- Collection of feedback and suggestions.

c. How can we improve or personalize our interactions with customers?

كيف يمكننا تحسين أو تخصيص تفاعلاتنا مع عملائنا؟

- Provide role-based training programs.
- Offer personalized support according to user roles.
- Create detailed user guides and tutorials.
- Collect feedback regularly to improve the platform.

4-Channels قنوات التوزيع :

a. Through which channels do our customers prefer to be reached?

من خلال أي قنوات يفضل عملاؤنا أن يتم التواصل معهم؟

- Direct presentations to dialysis centers and hospitals.
- On-site visits for demonstrations and deployment.
- Official website.
- Professional email communication.
- Medical conferences and healthcare events.

b. Which channels are most effective for reaching each customer segment?

ما هي القنوات الأكثر فعالية للوصول إلى كل فئة من العملاء؟

Healthcare Professionals

- On-site demonstrations.
- Training sessions.
- Professional communication channels.

Dialysis Centers and Hospitals

- Direct meetings.
- Pilot deployments.
- Official presentations.

Healthcare Authorities

- Formal reports.
- Professional meetings.
- Official correspondence.

c. How can we integrate different channels to improve customer experience?

كيف يمكننا دمج مختلف القنوات لتحسين تجربة العملاء؟

- Combine demonstrations, training, and support services.
- Provide continuous communication through email and phone support.
- Follow up after deployment to ensure successful adoption.

5-Key Partnerships: الشراكة الرئيسية:

a. Who are our key partners?

من هم شركاؤنا الرئيسيون؟

- Dialysis centers and clinics.
- Public and private hospitals.
- Ministry of Health.
- Cloud and hosting providers.
- Medical equipment suppliers.

b. Which partnerships help us reduce costs, access resources, or improve our value proposition?

ما هي الشراكات التي تساعدنا على خفض التكاليف أو الوصول إلى موارد جديدة أو تحسين قيمتنا المقترحة؟

- Hosting providers for infrastructure and cloud services.
- Dialysis centers for testing and validating the platform.
- Hospitals for wider deployment opportunities.
- Medical equipment suppliers for potential integrations.
- Ministry of Health for institutional support and adoption.

c. How can we align our interests with those of our partners?

كيف يمكننا مزامنة مصالحنا مع تلك لشركائنا؟

- Improve operational efficiency for healthcare institutions.
- Support digital transformation in healthcare facilities.
- Provide reliable and secure services.
- Continuously adapt the platform to clinical needs.

6-Key Activities:الأنشطة الرئيسية:

a. What are the main actions we must undertake to deliver our value proposition?

ما هي الأنشطة الرئيسية التي يجب علينا القيام بها لتقديم قيمتنا المقترحة؟

- Develop and improve the platform.
- Deploy the system in healthcare facilities.
- Train users.
- Provide technical support.
- Maintain and secure the system.
- Implement synchronization between local and hosted databases.

b. What are the essential operations for our business?

ما هي العمليات الأساسية لشركتنا؟

- Software development and maintenance.
- Database management.
- Technical support.
- User training.
- System monitoring and updates.

c. Which activities create the most value for our customers?

ما هي الأنشطة التي تخلق أكبر قيمة لعملائنا؟

- Patient management and monitoring.
- Dialysis session scheduling.
- Medical record management.
- Offline operation and synchronization.
- Reporting and statistics generation.

7-Key Resources:الموارد الرئيسية :

a. What are our essential physical, intangible, and human assets?

ما هي الأصول المادية وغير المادية والبشرية الأساسية لدينا؟

Physical Assets

- Servers and hosting infrastructure.
- Computers and networking equipment.

Intangible Assets

- The software platform.
- Database systems.
- Technical documentation.
- Medical workflow knowledge.

Human Assets

- Software developers.
- Technical support personnel.
- Healthcare domain experts.

b. What tools, technologies, or partnerships do we need to succeed?

ما هي الأدوات والتكنولوجيا أو الشراكات التي نحتاجها لتحقيق النجاح؟

Tools

- Development tools and frameworks.
- Database management systems.
- Monitoring and backup solutions.

Technologies

- Web technologies.
- Desktop application technologies.
- Database synchronization mechanisms.
- Security and authentication solutions.

Partnerships

- Dialysis clinics.
- Hospitals.
- Hosting providers.

c. What are the main competitive advantages of our resources?

ما هي المزايا التنافسية الرئيسية لمواردنا؟

- Specialized knowledge of hemodialysis workflows.
- Hybrid architecture supporting online and offline operation.
- Centralized management of medical and administrative information.
- Scalable and adaptable system architecture.

8-Coste Structure التكاليف:

a. What fixed and variable costs are associated with our business model?

ما هي التكاليف الثابتة والمتغيرة المرتبطة بنموذجنا الاقتصادي؟

Fixed Costs

- Hosting infrastructure (**15,000–40,000 DZD/year**).
- Domain name (**2,000–5,000 DZD/year**).
- System maintenance and updates (**20,000–50,000 DZD/year**).

Variable Costs

- Marketing and product demonstrations (**5,000–20,000 DZD/year**).
- Travel and deployment expenses (**10,000–30,000 DZD per clinic**).
- Custom feature development (**according to client requirements**).

b. What are the most important costs for our business?

ما هي التكاليف الأكثر أهمية لشركتنا؟

- Software development and updates.
- Hosting and database management.
- Technical support and maintenance.

c. How can we reduce costs or improve operational efficiency?

كيف يمكننا خفض التكاليف أو تحسين كفاءة عملياتنا؟

- Automate backup and synchronization processes.
- Standardize deployment and maintenance procedures.
- Reuse software components and modules

9-Revenue:مصادر الدخل :

a. What different ways can we generate revenue?

ما هي الطرق المختلفة التي يمكننا من خلالها تحقيق الدخل؟

- **SaaS Subscription Model**
  - Monthly subscription for access to the hosted web platform (**10,000–15,000 DZD/month**).
  - Annual subscription for access to the hosted web platform (**100,000–150,000 DZD/year**).
- **Hybrid Deployment Model**
  - One-time desktop application license (**150,000–200,000 DZD**).
  - **Free** Cloud synchronization and remote access included for the first **12 months**.
  - monthly subscription for cloud synchronization and remote access (**5,000–15,000 DZD/month**).
- **On-Premise Deployment Model**
  - One-time installation and deployment fee (**180,000–300,000 DZD**).
  - Optional maintenance and support contracts (**15–20% of software license value annually**).
- **Custom Development Services**
  - Additional features requested by clinics.
  - Integration with hospital information systems.
- **Training and Consulting**
  - User training.
  - Technical consulting and deployment assistance.

b. What is our pricing model?

ما هو نموذج التسعير لدينا؟

- SaaS: Monthly or annual subscription.
- Hybrid: One-time desktop license + reduced monthly synchronization fee.
- On-Premise: One-time deployment fee with optional maintenance contract.

10- business model canvas (BMC):

جامعة أبو بكر بلقايد
UNIVERSITY OF TLEMCEN

KEY PARTNERS

- Dialysis centers and clinics.
- Public and private hospitals.
- Ministry of Health.
- Cloud and hosting providers.
- Medical equipment suppliers.

KEY ACTIVITIES

- Software development.
- System deployment and integration.
- Platform maintenance and upgrades.
- Technical support.
- Continuous improvement based on user feedback.

KEY RESOURCES

Human Resources
- Software developers.
- System administrators.
- Technical support staff.
- Trainers and consultants.

Technical Resources
- Servers and hosting infrastructure.

Business Resources
- Medical expertise in nephrology.

VALUE PROPOSITION

this solution provides:
- Centralized management of medical and administrative information.
- Improved patient monitoring and treatment follow-up.
- Reduction of paperwork and manual errors.
- Better coordination between healthcare staff.
- Efficient scheduling of dialysis sessions.
- Real-time access to patient records and treatment history.
- Offline access through the desktop application when internet connectivity is unavailable.
- Data synchronization between local and hosted databases.
- Improved utilization of dialysis stations and resources.
- Generation of medical reports and operational statistics.

CUSTOMER RELATIONSHIP

User Training
- On-site and online training sessions.
- Video tutorials and knowledge base.

Technical Support
- Remote technical assistance.
- Corrective and preventive maintenance.

Customer Feedback
- Satisfaction surveys.
- Feature requests and improvement

CHANELS

- Direct sales to healthcare institutions.
- Official website.
- Medical conferences and healthcare exhibitions.
- Professional social media platforms.
- Partnerships with healthcare organizations.
- Demonstrations and pilot deployments.

CUSTOMER SEGMENTS

Primary Customer Segment
- Private dialysis clinics.

Secondary Customer Segment
- Hospitals with nephrology departments.
- Public dialysis centers.

COST STRUCTURE

- Hosting infrastructure (15,000–40,000 DZD/year).
- Domain name (2,000–5,000 DZD/year).
- System maintenance and updates (20,000–50,000 DZD/year).
- Marketing and product demonstrations.
- Travel and deployment expenses.
- Custom feature development.

REVENUE STREAMS

SaaS Subscription:
- 10,000–15,000 DZD/month.
- 100,000–150,000 DZD/year.

Hybrid Deployment :
- Desktop license: 150,000–200,000 DZD.
- Cloud synchronization included for 12 months.
- 60,000–120,000 DZD/year after the first year.

On-Premise Deployment:
- 180,000–300,000 DZD deployment fee.
- Additional hardware costs if required.
- Optional maintenance contract (15–20% annually)

Custom Services
- Additional features.
- System integrations.

Abstract

This thesis presents the design and development of a hemodialysis management platform intended to improve the organization of medical and administrative activities within dialysis centers. The proposed solution facilitates the management of patient records, dialysis sessions, appointments, treatment plans, laboratory results, and healthcare staff through dedicated interfaces adapted to different user roles.

The platform aims to simplify daily clinical workflows, improve information accessibility, and support healthcare professionals in delivering efficient patient care. By centralizing essential medical and administrative data within a single system, it contributes to better coordination, reduced manual work, and improved operational efficiency in dialysis centers.

Keywords: Hemodialysis, Dialysis Management System, Patient Management, Medical Records, Healthcare Information System.

Résumé

Ce mémoire présente la conception et le développement d'une plateforme de gestion des centres d'hémodialyse destinée à améliorer l'organisation des activités médicales et administratives. La solution proposée facilite la gestion des dossiers des patients, des séances de dialyse, des rendez-vous, des plans de traitement, des résultats d'analyses médicales ainsi que du personnel de santé grâce à des interfaces adaptées aux différents utilisateurs.

La plateforme vise à simplifier les activités quotidiennes, à améliorer l'accessibilité des informations et à accompagner les professionnels de santé dans le suivi des patients. En centralisant les données médicales et administratives au sein d'un système unique, elle contribue à une meilleure coordination des services, à la réduction des tâches manuelles et à l'amélioration de l'efficacité des centres d'hémodialyse.

الملخص

يقدم هذا العمل تصميم وتطوير منصة لإدارة مراكز تصفية الدم بهدف تحسين تنظيم الأنشطة الطبية والإدارية داخل مراكز تصفية الدم. تتيح المنصة إدارة ملفات المرضى، جلسات التصفية، المواعيد، خطط العلاج، نتائج التحاليل الطبية، بالإضافة إلى إدارة طاقم العمل الصحي من خلال واجهات مخصصة تتناسب مع صلاحيات كل مستخدم.

تهدف المنصة إلى تبسيط سير العمل اليومي، وتحسين الوصول إلى المعلومات، ومساعدة الطواقم الطبية في متابعة المرضى بكفاءة أكبر. ومن خلال توحيد البيانات الطبية والإدارية داخل نظام واحد، تساهم المنصة في تحسين التنسيق بين مختلف المستخدمين، وتقليل الأعمال اليدوية، ورفع كفاءة تسيير مراكز تصفية الدم