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SWENG 837 Software System Design

Final Project

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Project Details

Healthcare Software Engineering: This field is gaining prominence with substantial investments to enhance software quality in healthcare. The primary goals include improving employee efficiency, enhancing patient experiences, and streamlining medical care delivery.

Potential Systems:

- **Unified Patient Manager**: Centralized access to patient data with stringent security measures.
- **MediFind**: An easily accessible medicine database offering comprehensive drug descriptions via QR codes.
- **Qalb+**: A platform facilitating the search for nearby healthcare providers and doctors, considering specialties and accepted insurance types.
- **KLIK**: A web application fostering community engagement and alleviating loneliness among patient communities by creating support groups.

Business statement

The Unified Service Provider system will be a customer-facing platform that integrates the following services: Unified Patient Manager, MediFind, Qalb+, KLIK, and Billing Services. The system is designed to simplify and streamline processes for both patients and medical providers, ensuring the delivery of high-quality health care.

System Requirements

- The system shall provide a centralized database for patient data
  - The Unified Patient Manger subsystem shall allow user to view, update, and manage patient records
- The system shall provide a medical database for drug descriptions
  - The MediFind subsystem shall enable searches using QR codes.
  - The MediFind subsystem shall analysis all of the users' prescriptions for known complications
  - The MediFind subsystem shall notify users when a drug complication is detected
- The system shall provide a database of healthcare providers
  - The Qalb+ subsystem shall allow user to search for providers based on user preferences
  - The Qalb+ subsystem shall display the types of accepted insurances by each healthcare provider
- The system shall provide a database of support communities
  - The KLIK subsystem shall allow user to search for support communities based on user preferences
- The system shall provide a billing system service
  - The Billing subsystem shall provide various payment methods.
  - The Billing subsystem shall automate pricing based on insurance policies
- The system shall allow patients to schedule appointments with their medical providers
- The system shall be able to be access on multiple platforms and devices

Non-Functional Requirements (1 of 2)

Performance

- The system shall respond to user queries within 5 seconds
- The system shall provide search results within 10 seconds of a query
- The system shall load user's patients records within 5 seconds
- The system shall allow up to 1,000 simultaneous users
- The system shall limit the number of user to simultaneous access a single patients records to 5 users.

Security

- The system shall implement multifactor authentication
- The system shall implement strict security process to protect all data
- The system shall implement role base access controls.

Usability

- All search functions shall be customizable
- All search results shall allow customizable filters
- The systems UI shall be intuitive and user friendly.

Non-Functional Requirements (2 of 2)

Reliability

- The system shall be able to synchronize data from multiple sources
- The system shall be able to aggregate data from multiple source

Scalability

- The system shall be designed to allow scalability for future growth.
- The system shall be designed to handle a sudden influx of users.
- The system shall be able to integrate with existing healthcare systems

Use Case Analysis – Primary Actors

Type	Actor	Goal Description
Primary	Patient	Receive top quality healthcare to improve quality of life. • Access personal healthcare records • Schedule appointments • Communicate with healthcare providers • View test results • Manage health related tasks. • Access support groups
Primary	Doctor	Provide top quality healthcare coverage by accurate diagnoses and provide treatment to patients. • Access patient health records • Document medical notes • Prescribe medications • Order tests • Review test results • Communicate with patients • Manage patient appointments.
Primary	Nurses	Provide top quality healthcare coverage by support doctors and administrating doctors • Access patient health records • Take and record patient vitals • Update patient medications • Administrate care

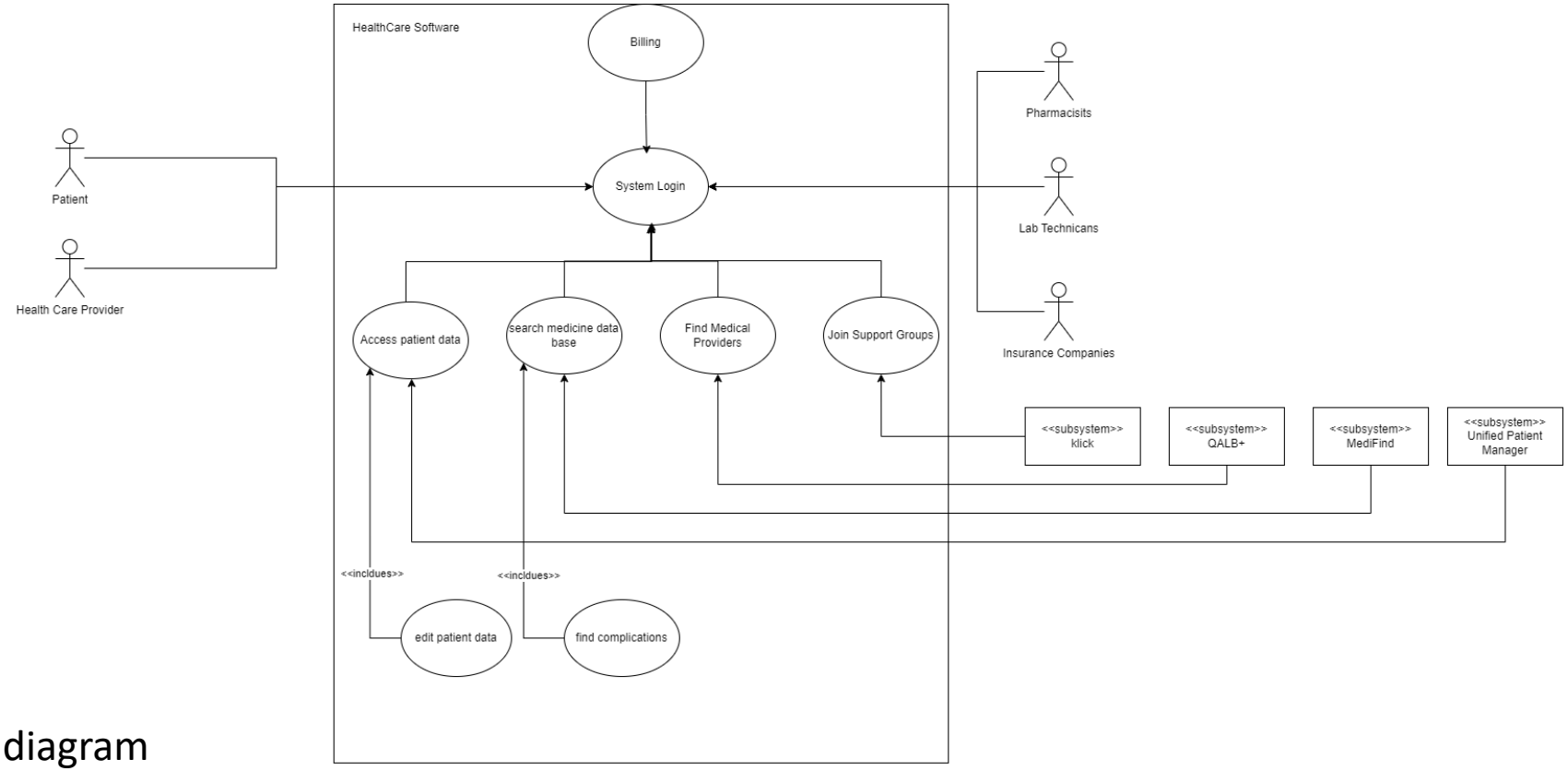
Use Case Analysis – Supporting Actors

Type	Actor	Goal Description
Supporting	Pharmacists	Provide medication and counseling to patients. • Access electronic prescriptions • Dispense medication • Verify drug interactions • Provide counseling on medication • Alert patient when prescriptions are ready for pickup
Supporting	Lab Technicians	Conduct, analyze, and record medical test results. • Receive test orders • Administer tests • Record test results.
Supporting	Pharmacists	Provide medication and counseling to patients. • Access electronic prescriptions • Dispense medication • Verify drug interactions • Provide counseling on medication • Alert patient when prescriptions are ready for pickup

Use Case Analysis – Offstage Actors

Type	Actor	Goal Description
Offstage	U.S. Department of Health and Human Services (HHS)	The HHS will require that all federal regulations such as the Health Insurance Portability and Accountability Act (HIPPA) are met.
Offstage	Medical Coders	Review and assign standard codes based on medical services received and insurance for billing.
Offstage	Pharmaceutical companies and research labs	Receive the lasted news on medical technologies and enhancements. Receive updates on • New approved drugs • Process and procedures • Clinical trials

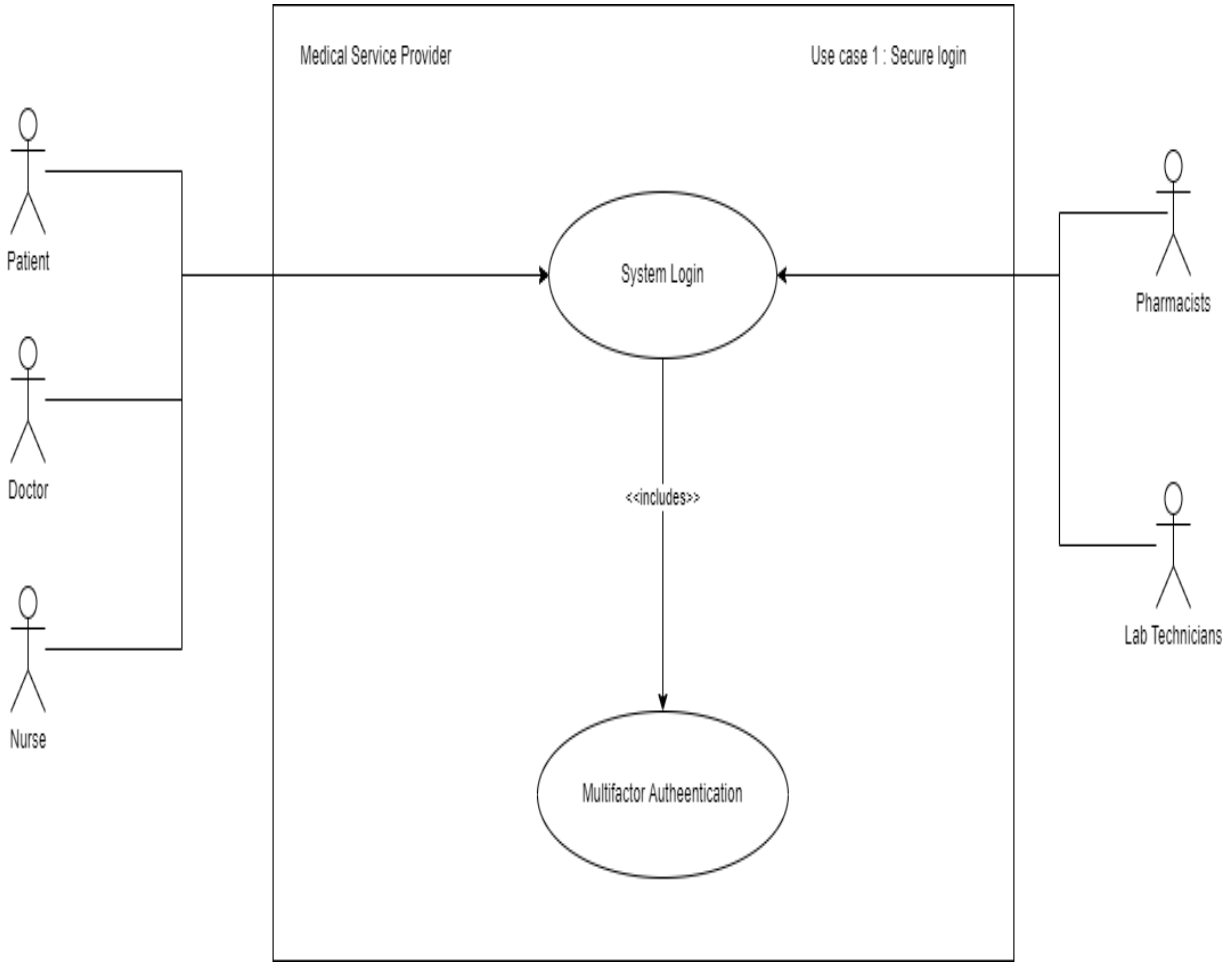
High Level – Overall Use Case Diagram



High Level System Use case diagram showing primary actors, support actors, and subsystems

Use Case 1 – Secure Login

Use Case Specification	Description
Use Case Name	Secure login
Scope	Overall system, Security
Level	User Goal
Primary Actor	Patient, Medical Provider (Doctors, Nurses)
Stake holders and interests	Ensures that only authorized uses can access personal/medical information
Pre-conditions	User must create a valid account. User must have multifactor authentication enabled.
Success Guarantee	User uses multifactor authentication to access the system
Main Success scenario	1. Patient logs into system using username & password 2. System validates patient's login credentials 3. System activates multifactor authentication 4. Multifactor authentication sends patient unique pin 5. Patient enters unique pin 6. Multifactor validates unique pin and sends confirmation to system 7. System receives authentication and allows user access to system.
Extensions	• User inputs the wrong username and password combination • User forgets password • User does not receive multifactor authenticator pin

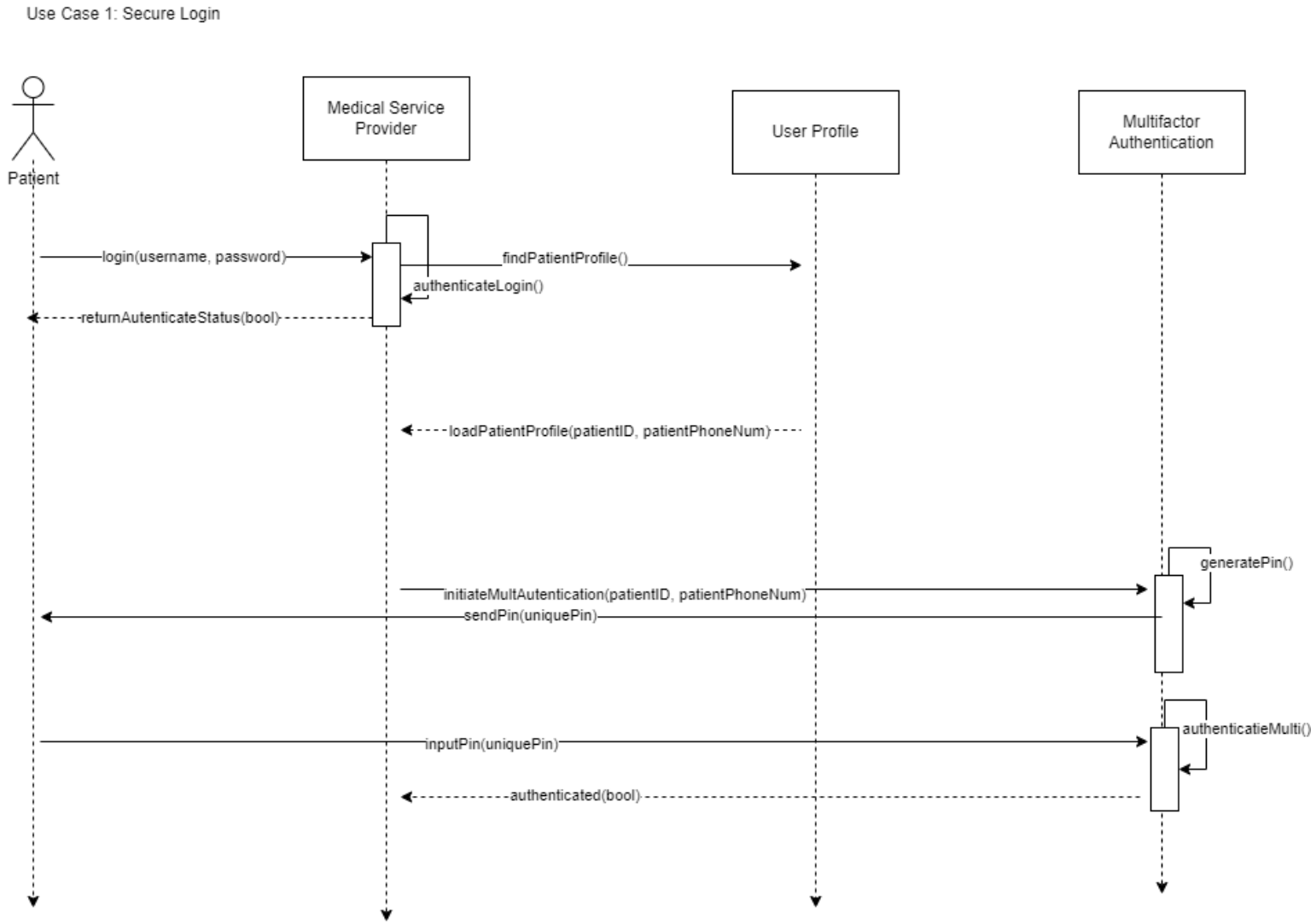


Use Case 1 – Secure Login

User enters username and password
System authentication login against user profile

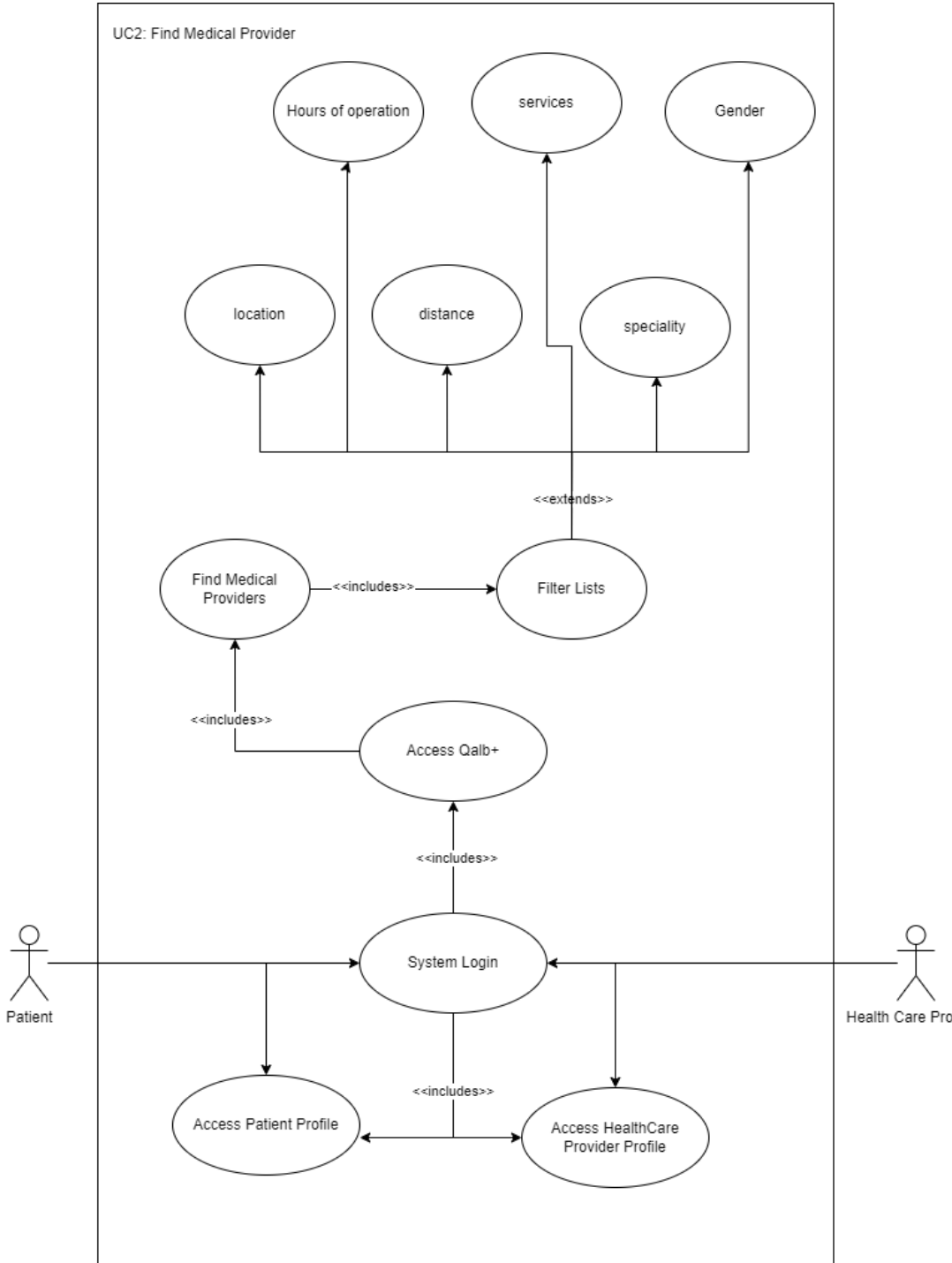
System load user profile and initiates multifactor authentication

Multifactor authentication authenticates user and allows access to the system



Use Case 2 – Find Medical Provider

Use Case Specification	Description
Use Case Name	Find Medical Provider
Scope	**Qalb+**: A platform facilitating the search for nearby healthcare providers and doctors, considering specialties and accepted insurance types.
Level	User Goal
Primary Actor	Patient
Stake holders and interests	Doctors: Update the profiles so that patients can find them by availability, location, hours of operation, specialty, accepted insurance, experience, etc.
Pre-conditions	Patient has completed login process and now has access to the system
Success Guarantee	Patient is able to find a medical provider based on their preferences
Main Success scenario	1. Patient is able to search for all medical providers by location 2. Patient is able to refined search results with their preferences 3. Patient is able to select a medical provider and view more detailed information
Extensions	Medical Provider profile is not up to date Medical Provider does not have a profile in the database

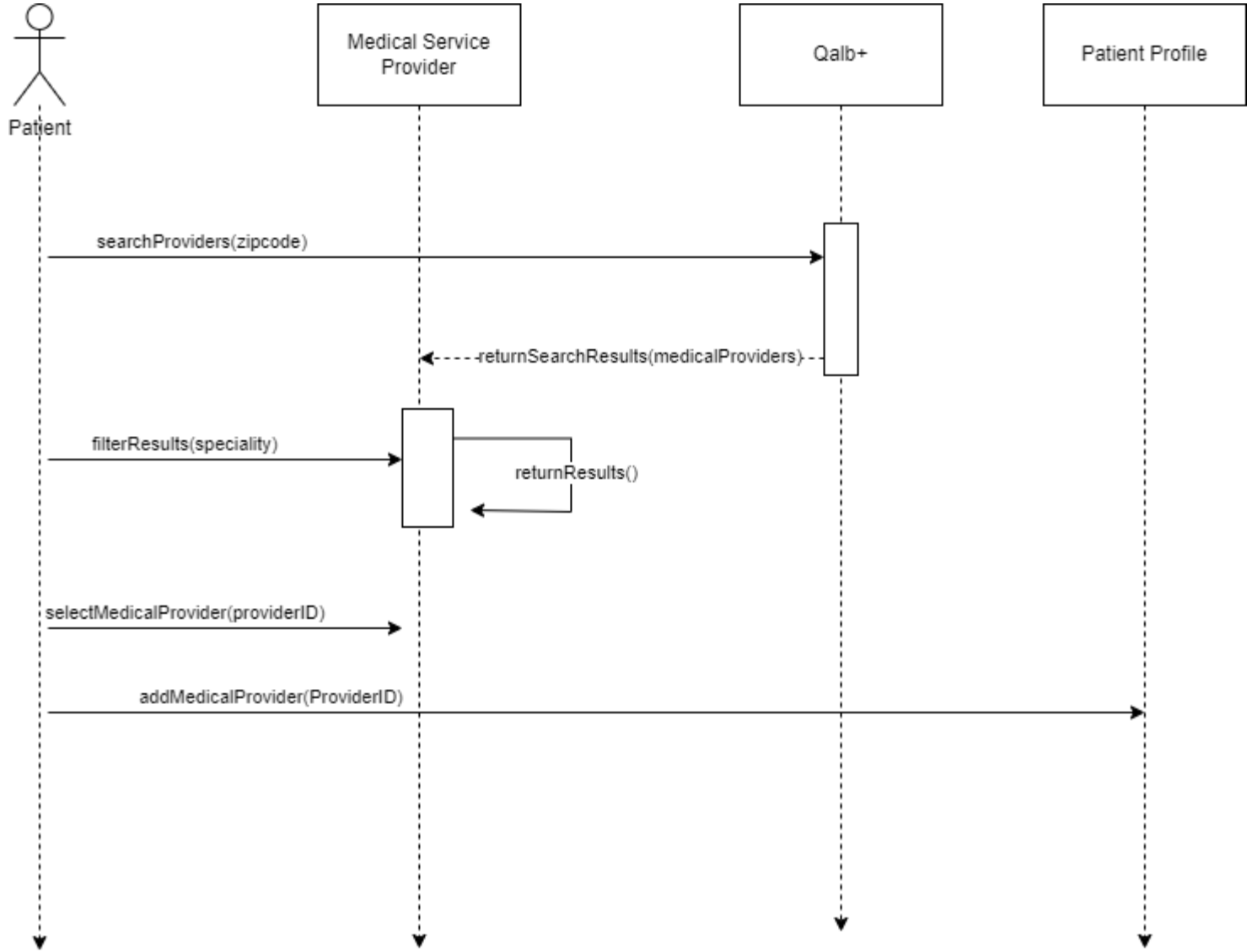


Use Case 2 – Find Medical Provider

User initiate search for medical providers based on location

User refines search results with filters

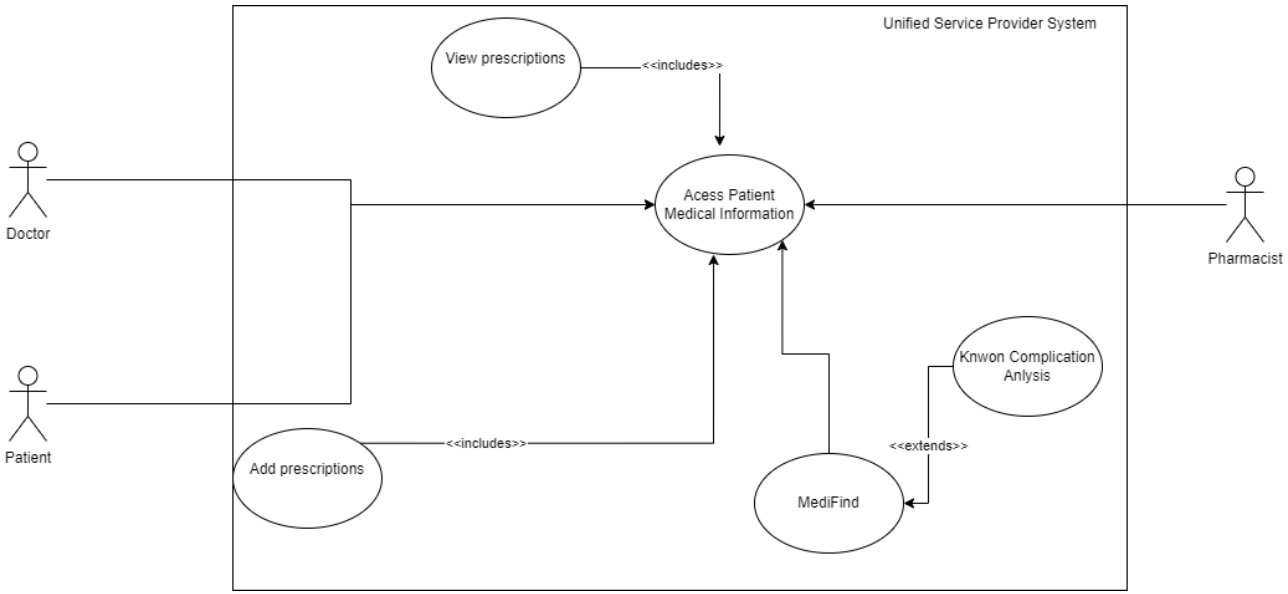
User selects a medical provider and adds them to their list of Medical Providers

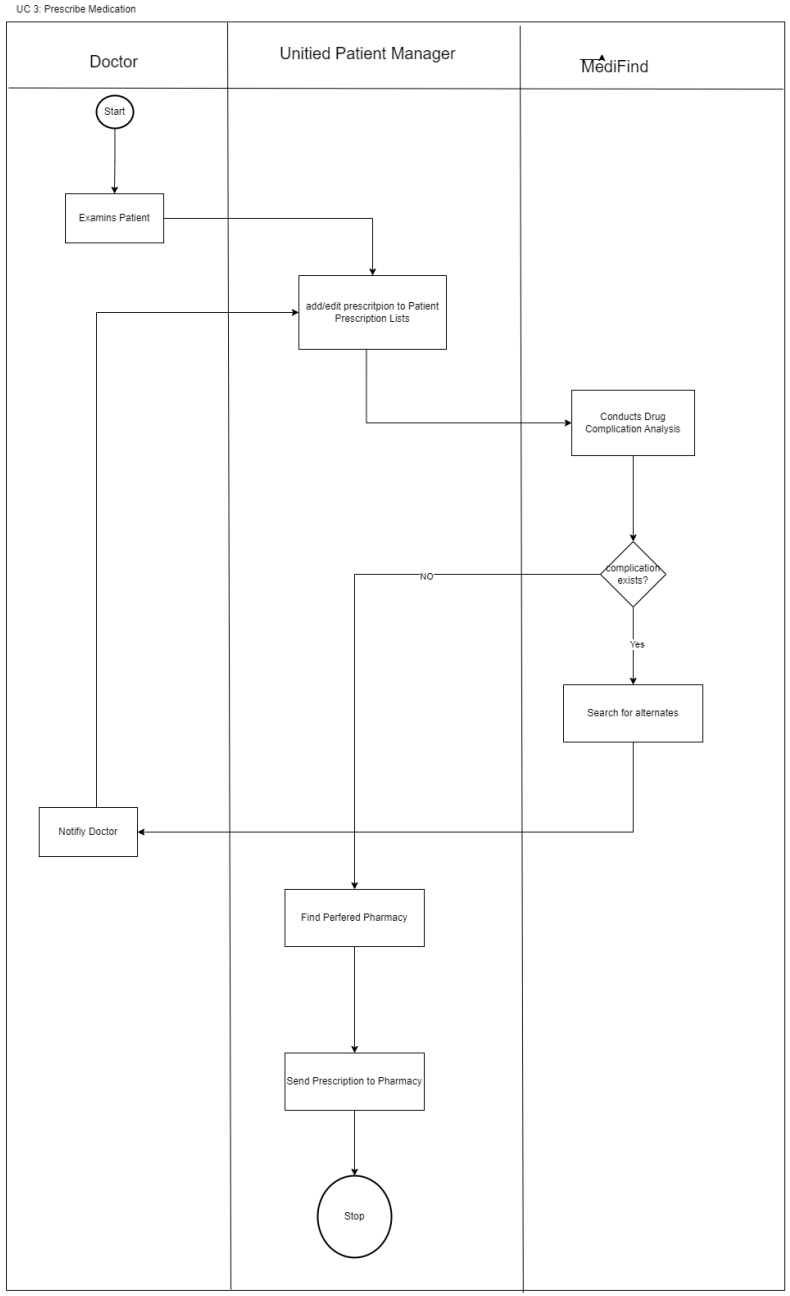


Use Case 3 – Prescribe Medication

Use Case Specification	Description
Use Case Name	Prescribe Medication
Scope	MediFind: An easily accessible medicine database offering comprehensive drug descriptions via QR codes.
Level	User goal
Primary Actor	Doctor
Stake holders and interests	Patient: Patient relieves the proper medication for treatment Pharmacy: Pharmacy receives the prescription to fill for patient Insurance Company: Approves and provides billing information
Pre-conditions	Patient has preferred pharmacy on file Doctor has completed login to the system and has access to patient medical records.
Success Guarantee	Doctor writes prescription into patient prescription lists. Prescription is sent to pharmacy on file in patients records.
Main Success scenario	1. Doctor adds new prescription to patients' prescription lists 2. MediFind notifies doctor that there are no known complications with current medications 3. Prescription is electronically sent to pharmacy on file
Extensions	• A complication was found in MediFind

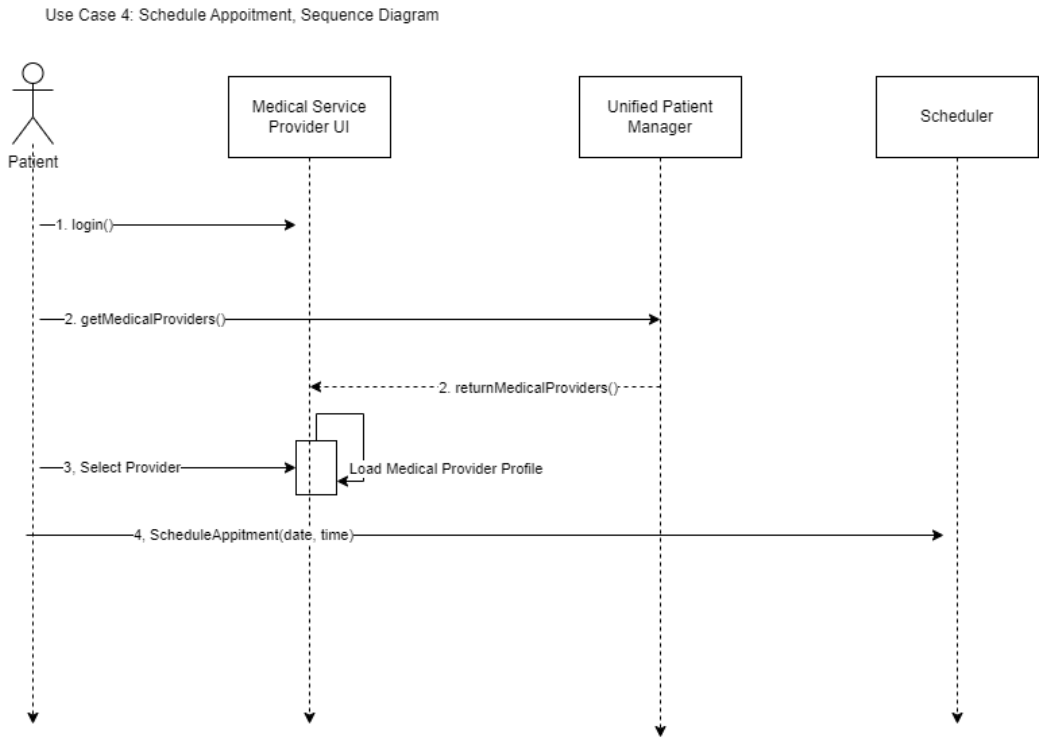
Use Case 3 – Prescribe Tests





Use Case 4 – Prescribe Test

Use Case Specification	Description
Use Case Name	Prescribe tests
Scope	Scheduler
Level	User goal
Primary Actor	Patient
Stake holders and interests	Doctors, Labs. So, they can allocate sufficient time to administer proper care.
Pre-conditions	Patient must have valid account. Patient must have primary physician, specialists, pharmacy, and insurance information on file. Patient completes to login process
Success Guarantee	Patient arrives at medical provider on time and is able to see provider within 30 minutes of appointment time.
Main Success scenario	1. System loads all of patient's medical providers 2. Patient selects a medical provider and access their calendar 3. Patient request an appointment at request time and date 4. System sends request to medical provider 5. Medical provider accepts appointment request
Extensions	• Medical Provider has no availability on their calendar • Medical provider rejects appointment request • Patient wants to cancel or reschedule an appointment



Analysis of this use case revealed the need for a scheduler

Use Case 4 – Prescribe Test

Use Case Specification	Description
Use Case Name	View Test Results
Scope	Unified Patient Manager: Centralized access to patient data with stringent security measures.
Level	User goal
Primary Actor	Patient
Stake holders and interests	Doctor: Doctor is able to view test results and provide comprehensive follow up care
Pre-conditions	Patient has completed the required test. Lab Technician/Medical Provider has logged into the system. Lab Technician/Medical Provider are authorized to view/edit patients' medical information
Success Guarantee	Patient is able to view test results.
Main Success scenario	1. Lab Technican/Medical Provider enters test results into patients' medical history 2. System sends a notification to patient and primary physician that test results are available. 3. Patient logs into the system 4. Patient access medical history and views test results
Extensions	• Medical provider does not have access rights to patient records

Use Case 4 – Prescribe Test

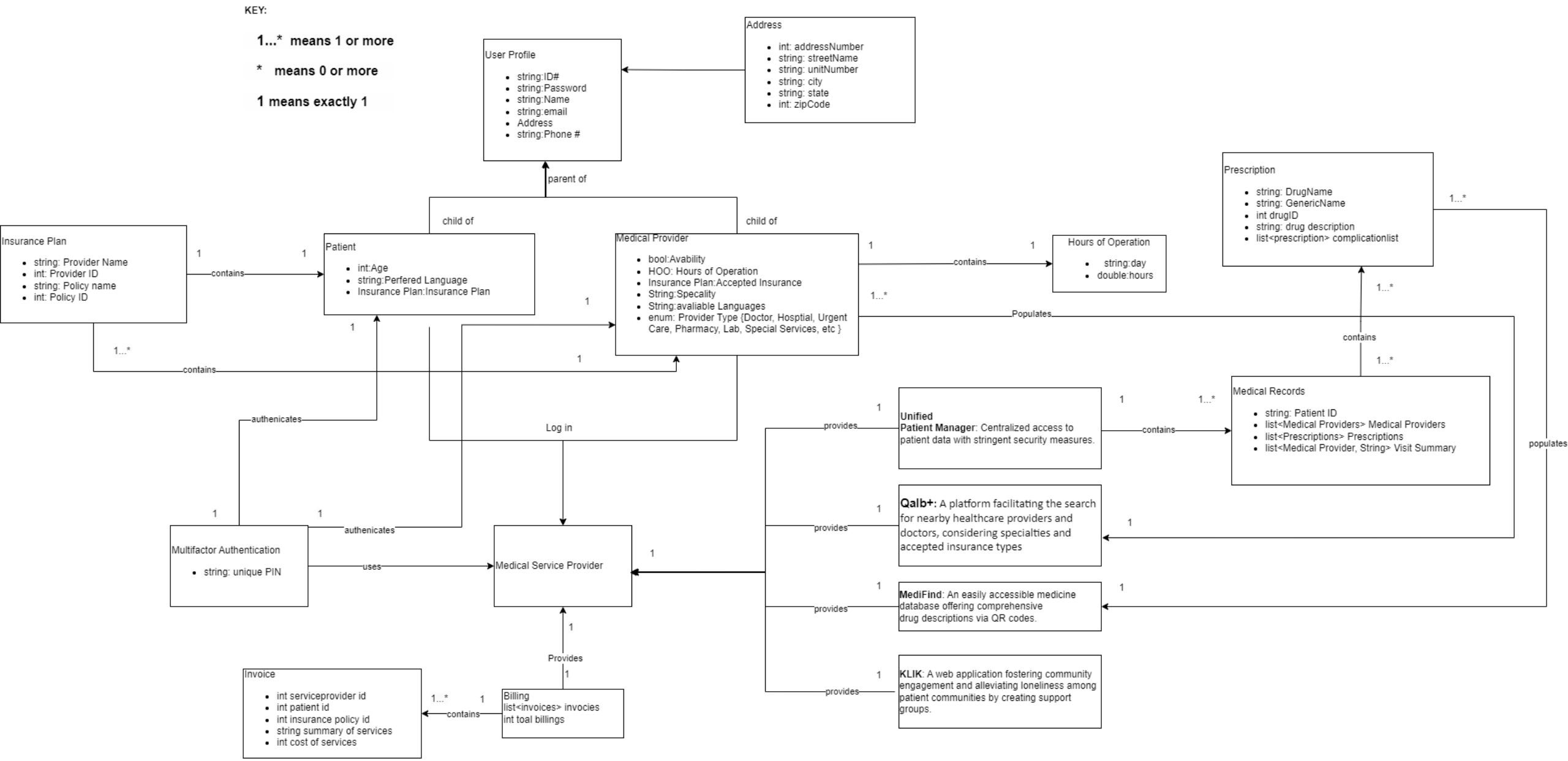
Use Case Specification	Description
Use Case Name	View Test Results
Scope	Unified Patient Manager: Centralized access to patient data with stringent security measures.
Level	User goal
Primary Actor	Patient
Stake holders and interests	Doctor: Doctor is able to view test results and provide comprehensive follow up care
Pre-conditions	Patient has completed the required test. Lab Technician/Medical Provider has logged into the system. Lab Technician/Medical Provider are authorized to view/edit patients' medical information
Success Guarantee	Patient is able to view test results.
Main Success scenario	1. Lab Technican/Medical Provider enters test results into patients' medical history 2. System sends a notification to patient and primary physician that test results are available. 3. Patient logs into the system 4. Patient access medical history and views test results
Extensions	• Medical provider does not have access rights to patient records

Domain Model

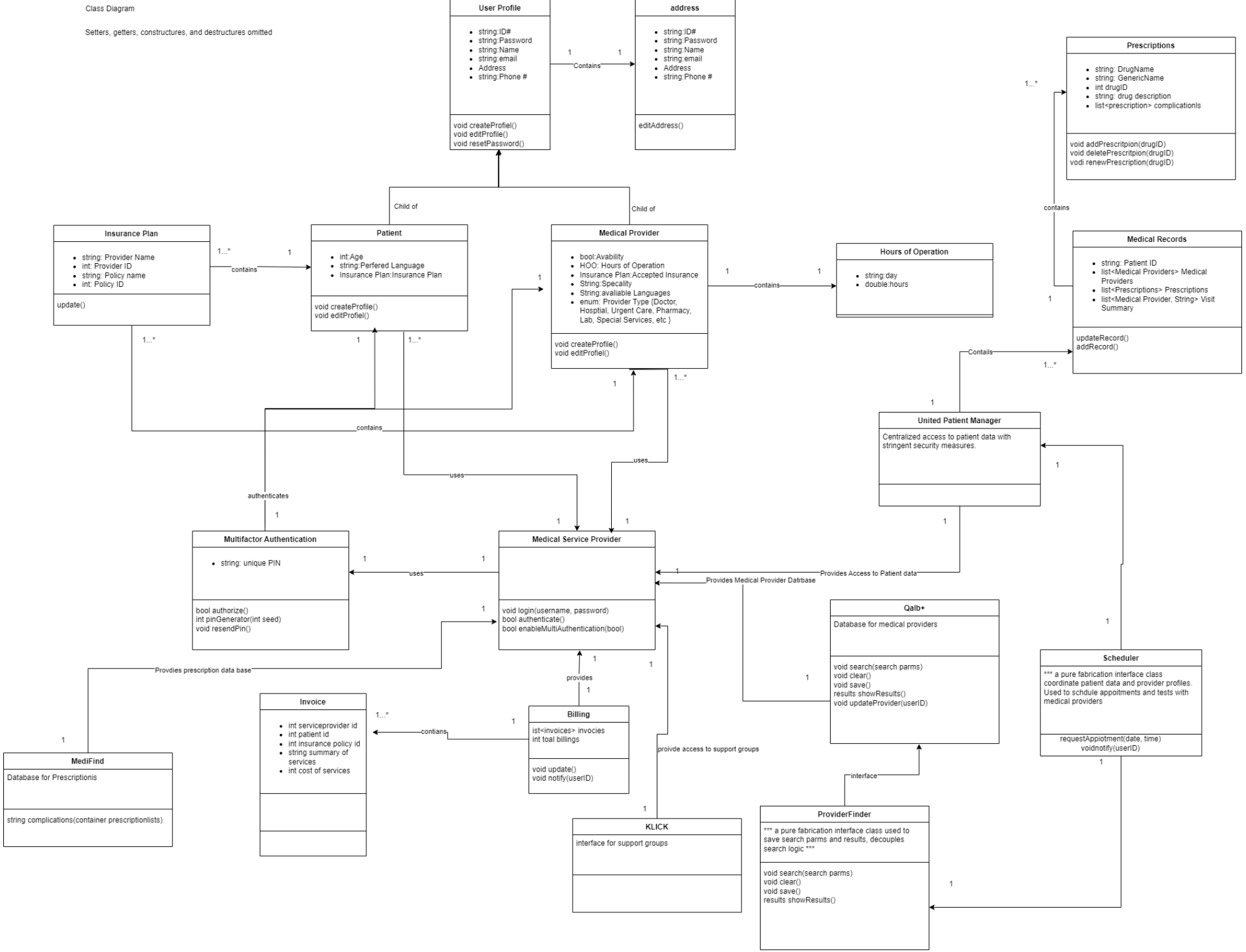
Conceptual Class Category	Example of Medical Service Provider (MSP)
Physical or Tangible Objects	Computer, Input Device, Display
Specifications, Designs or Descriptions of Things	Patient Information, Insurance Plans, Medical Service Providers, User Profile, Unified Patient Manager, Qalb+, MediFind, KLIK
Places	Proximity to patient, Clinic, waiting room, pharmacy
Transactions	Find Medical Provider, insurance claims, discharge
Transaction Line Items	Insurance Plan, zip code, Medical Services
Roles of People	Patient, Provider, Pharmacy, Lab Technician
Containers of Other Things	Patient Information, Insurance Plan, Medical Service Provider, Prescription List, patient folders
Things in a Container	Age, Sex, Name, Hours of Operation, Address, Drug Name, Prescriptions
Other Computers/Systems (external)	Databases
Abstract Noun Concepts	Authenticate, Security,
Organizations	Hospitals, Insurance Providers
Events	Find health care provider, find support group, get drug information
Processes	Update information, find healthcare provider, find social groups
Rules and polices	HIPPA, cyber security
Catalogs	Insurance Options, Healthcare options
Record of Finance, Work, Contracts, Legal Matters, etc,	Billing, Medical Records,
Financial Instruments and Services	Insurance Rates
Manuals, Books, Documents, Reference Paper	Drug Descriptions

Good	Bad
User Profile	Computer, input device, display, proximity to patient, clinic, waiting room, pharmacy, find medical provider, insurance plan, zip code, discharge, insurance claims, age, sex, name, address, drug name, Databases, patient folders, healthcare options, drug descriptions
Patient Profile	
Insurance Plan	
Medical Provider	
Billing	
Hours of Operation	
Qalb+	
MediFind	
KLIK	
Unified Patient Manger	
Prescription	
Multifactor Authentication	
Medical Service Provider	

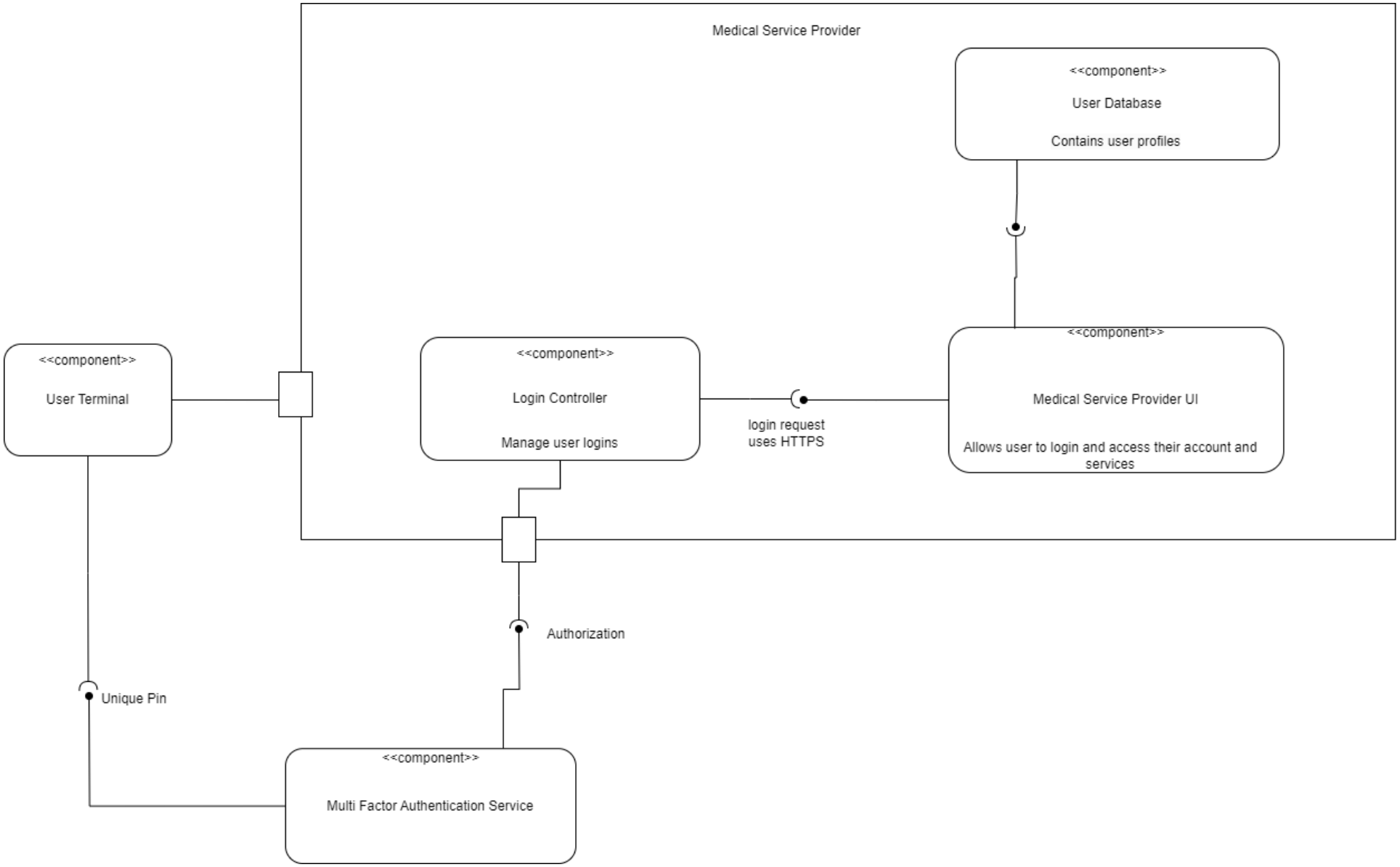
Domain Model



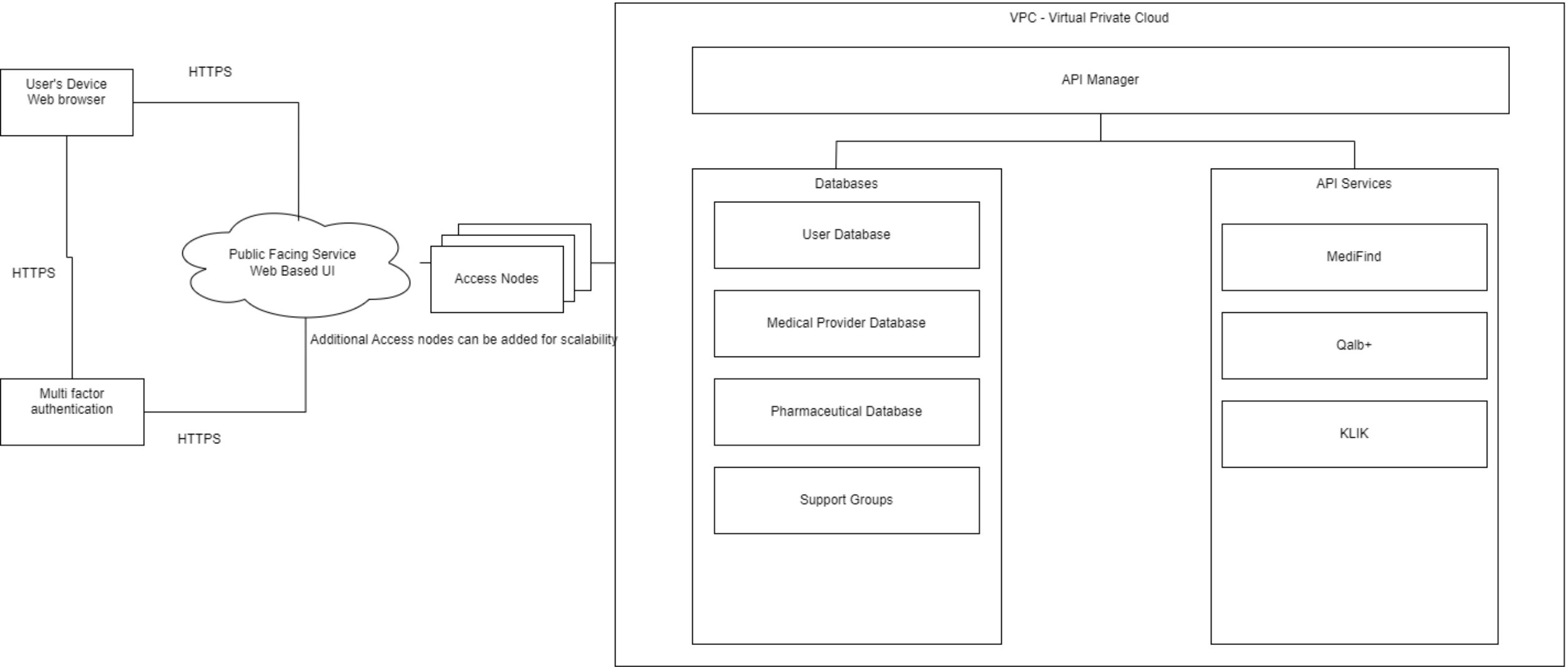
Class Diagram



Component Diagram



Deployment Diagram



Design Principles & Patterns

General Responsibility Assignment Software Patterns

Polymorphism & inheritance used when possible for to reduce code redundancy

- Example: Parent Class User Profile, Child Classes: Patient Profile & Medical Provider Profile

Pure Fabrication: Introduced Pure Fabrication class to decouple capabilities that require collaboration from multiple databases

SOLID
Single responsibility Principle, Tried to design classes that focused on a single thing

Databases

The Unified Service Provider system contains 5 Databases	
Authentication Credentials	Contains User’s login credentials
Unified Patient Manager	Patient Data
MediFind	Drug Data
Qalb+	Medical Providers Data
KLIK	Support Groups

The Unified Service Provider is a cloud base system and will utilize the Microservices architecture.

The microservices pattern allows each data base to be managed separately.

Conclusions

The goal of the design of the Unified Service Provider system is to use proved existing technologies to reduce the complexity of this system. The built in security features of google authenticator and AWS services greatly reduced the complexity and development time. Following the Keep it simple methodology, each class was design to do 1 thing.

Lessons Learned: The used of class diagram and design principles will help me simplify and plan out future software projects. The introduction of the domain model was a new concept that I found helpful to shape the scope of this project.

In additional to lessons learned, I would like to dive deeper in the AWS cloud service and infrastructure to the a better understanding of AWS.