

Hospital Management System

**Data Modelling and Databases I
BS18-05**

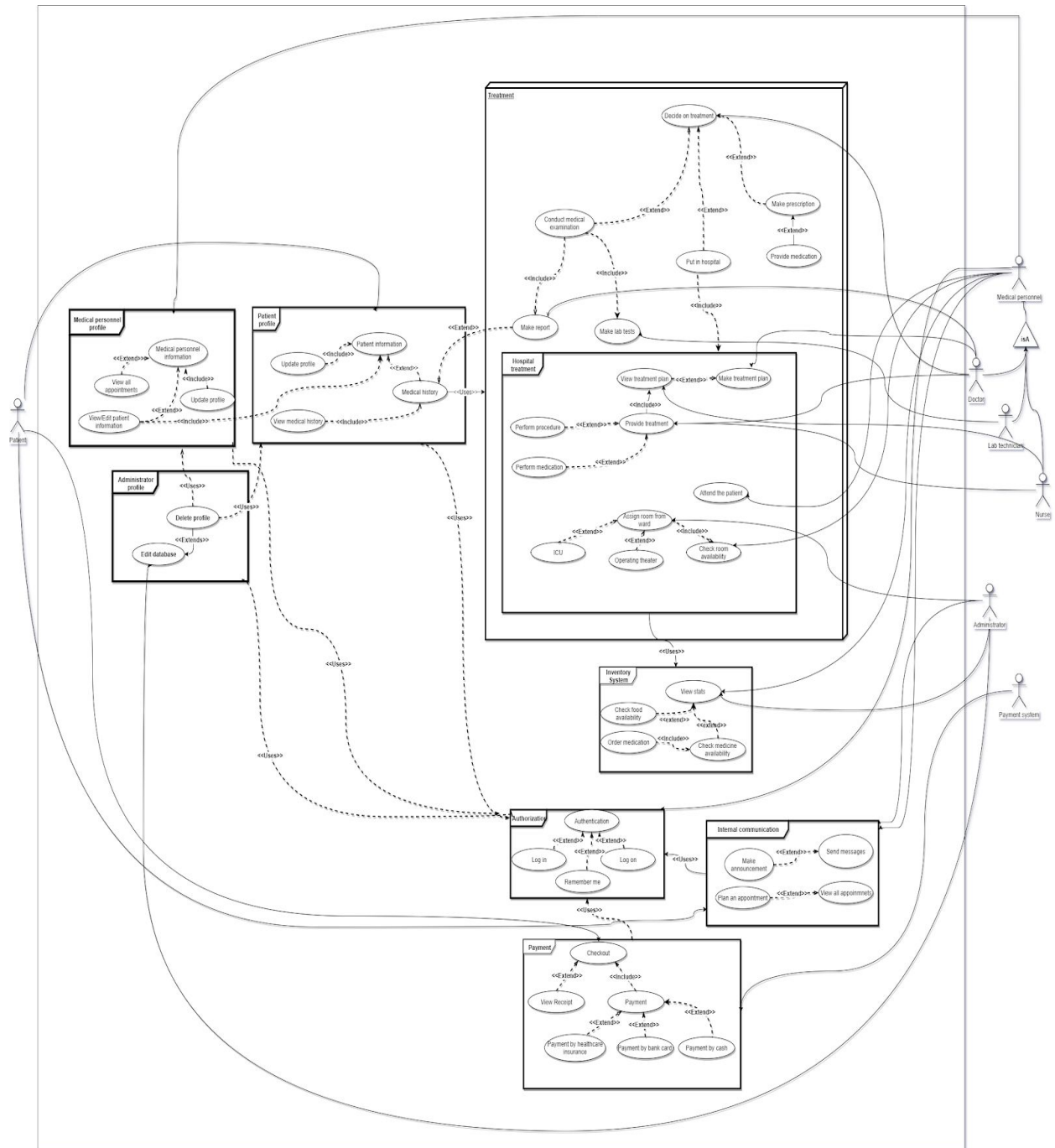
**Andrey Feygelman
Ivan Abramov
Magomed Magomedov**

Table of content

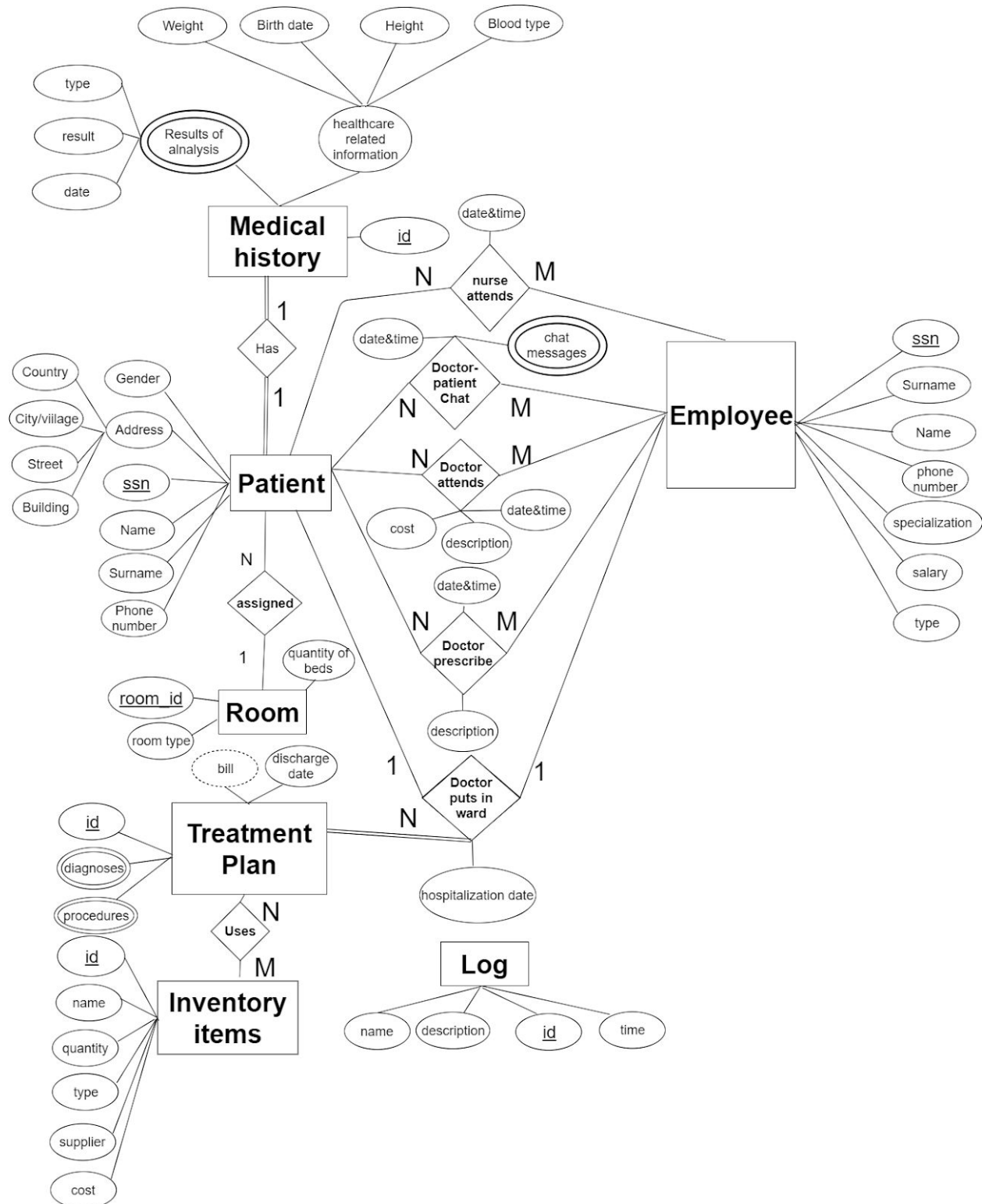
- I. [Use case diagram](#)
- II. [Entity-relationship model](#)
- III. [Annotation](#)
- IV. Requirements
 - A. [General](#)
 - B. [Authorization](#)
 - C. [Outpatient care](#)
 - D. [Profiles](#)
 - E. [Ward system](#)
 - F. [Inventory](#)
 - G. [Chat system](#)
 - H. [Payments](#)

I. Use case diagram

<https://drive.google.com/open?id=1eITsesQTpa1HPKID8ID5fTEzXGUWXOER>



https://drive.google.com/file/d/1a9wEQg2x_AF9P9a613ltVPXLBFxTn56y/view?usp=sharing



Weak entities	1) The treatment plan is a weak entity because it cannot be uniquely identified by its attributes alone. The treatment plan is uniquely identified by the composition of treatment ID, SSN of the doctor, who makes it and patient MRN through relation «Doctor puts in ward».
Strong entities	1) Employee, Patient, Log, Inventory items, Room and Medical History are strong entities because they are identified by correspondent keys and their existence does not depend on the existence of any other entity in a schema.
Total participation	<p>1) The treatment plan is involved in relation «Doctor puts in ward» totally because it is a weak entity and it is uniquely identified through this relation.</p> <p>2) Medical history and Patient both participate in relation «Has» totally because every Patient must have exactly one Medical History and every Medical History must have exactly one Patient.</p>
Partial participation	<p>1) Relations: «Assigned», «Uses», «Nurse attends», «Doctor attends», «Doctor-patient chat», «Doctor prescribe» have entities who all participate partially, because not all entities are involved in these relationships.</p> <p>2) Employee partially participate in the relation «Doctor puts in ward» because not all employees participate in this relation.</p>
Multi-valued attributes	1) Chat messages, Results of analysis, Appointment protocols are multivalued attributes because they can have more than one value associated with the key of the entity.
Single-valued attributes	1) All attributes except multi-valued (mentioned above) are single-valued because they can have only a single value at a particular instance of time associated with the key of the entity.

Derived attributes	<p>1) Bill is a derived attribute because its value is calculated (derived) from other attributes. (Quantity and cost of Inventory items)</p>
N to M relation	<p>1) Relations: «Uses», «Nurse attends», «Doctor attends», «Doctor-patient chat», «Doctor prescribe» are N to M relations because for instance there can be chats of one user with several doctors (Employee of type doctor) and one doctor can have chats with many patients.</p>
One to one relation	<p>1) Medical history - Has - Patient is one to one relation because medical history must have exactly one patient and patient must have exactly one medical history.</p> <p>2) Patient and Employee of type doctor are involved in the relation «Doctor puts in ward» with participation «One» because at a time exactly one doctor can put exactly one patient into ward.</p>

III. Annotation

Our system is designed for full data management of a hospital with special focus on its inpatient (ward) department. The system has several subsystems, each of which designated for its real-world counterpart.

Authentication system through which users (patients, medical personnel and administrators) can log in or log on (with the help of an administrator). Depending on an account type provided of the system, patients can edit their basic info and view their appointments, doctors can view and edit appointments and as well as have access to medical history of each particular patient, and administrators can manage personal and view other systems data.

Internal communication system requires authentication and includes *chat* (patient-doctor, doctor-doctor), *notice board* (important announcements) and *appointments view*.

Treatment is where the main interactions between patient and medical personnel happen, stored, and subsequently are being compiled into patients' *medical history*. The examples of records are prescriptions, medications given and reports from medical examinations which might include results of lab analysis.

Treatment includes the whole **inpatient care** department management system. Patients under inpatient care has their whole treatment process information there (timespan during which they were under the ward, treatment plan, treatment result etc.).

Inpatient care is tightly integrated with **inventory** system, that automatically tracks amount of medications available (and provided), beds occupied, meal plan provided. This system is also capable of giving analytical data of usage of resources.

Payment system is responsible for tracking cost of all services provided by the hospital, composing them into a single bill, and accepting various payment methods, such as cash, credit card or even payments from insurance company

Risk description:

- Critical (C) It will break the main functionality of the system. The system cannot be used if this requirement is not implemented.
- High (H) It will impact the main functionality of the system. Some function of the system could be inaccessible, but the system can be generally used.
- Medium (M) It will impact some system features, but not the main functionality. The system can still be used with some limitations.
- Low (L) The system can be used without limitation, but with some workarounds.

IV. Requirements

A. General

Functional

<i>ID</i>	general_f1
<i>Title</i>	Medical personnel data access
<i>Type</i>	Functional
<i>Description</i>	All medical personnel have access to information about all patients, each other's schedule, current ward status.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	general_f2
<i>Title</i>	System administrator's rights
<i>Type</i>	Functional
<i>Description</i>	Administrator(s) has unlimited access to the whole system.
<i>Priority</i>	1
<i>Risk</i>	High

Non-functional

<i>ID</i>	general_n1
<i>Title</i>	Small system response time
<i>Type</i>	Non-functional
<i>Description</i>	The user-interface shall respond within 2 seconds.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	general_n2
<i>Title</i>	Frequent data backup
<i>Type</i>	Non-functional
<i>Description</i>	The system shall provide the capability to back up all stored data.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	general_n3
<i>Title</i>	Unified medical record number
<i>Type</i>	Non-functional
<i>Description</i>	Patients should be Identified by Medical record number. (MRN)
<i>Priority</i>	1
<i>Risk</i>	High

<i>ID</i>	general_n4
<i>Title</i>	Support high patient load
<i>Type</i>	Non-functional
<i>Description</i>	System must be able to service a high number (a million) of concurrent users.
<i>Priority</i>	1
<i>Risk</i>	High

<i>ID</i>	general_n5
<i>Title</i>	Store system error log
<i>Type</i>	Non-functional
<i>Description</i>	System should keep a log of all the errors.
<i>Priority</i>	2
<i>Risk</i>	Medium

<i>ID</i>	general_n6
<i>Title</i>	Follow accessibility standards
<i>Type</i>	Non-functional
<i>Description</i>	The systems must conform to the Microsoft Accessibility guidelines.
<i>Priority</i>	2
<i>Risk</i>	Medium

B. Authorization

Functional

<i>ID</i>	authorization_f1
<i>Title</i>	Patients registration and data
<i>Type</i>	Functional
<i>Description</i>	Patients can create account. Information that should be stored about patients: <ul style="list-style-type: none">• MRN• name and surname• address• gender• phone number• medical history
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	authorization_f2
<i>Title</i>	Medical personnel registration and data
<i>Type</i>	Functional
<i>Description</i>	An admin should be able to add a new user of type doctor, lab technician, nurse and admin to the system. Information that should be stored about medical workers: <ul style="list-style-type: none">• ssn• name and surname• phone number• specialization• salary
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	authorization_f3
<i>Title</i>	Patients and medical personnel authorization
<i>Type</i>	Functional
<i>Description</i>	Patients and medical personnel can authorize online through official hospital's website.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	authorization_f4
<i>Title</i>	Delete patient ID
<i>Type</i>	Functional
<i>Description</i>	The administrative staff can delete patient info from the system.
<i>Priority</i>	1
<i>Risk</i>	Medium

C. Outpatient care

Functional

<i>ID</i>	outpatient_care_f1
<i>Title</i>	Doctor and patients medical history
<i>Type</i>	Functional
<i>Description</i>	<p>Doctor can update their patient's medical history. Medical history should contain</p> <ul style="list-style-type: none">• Appointment protocols• Treatment plans• Medical data:<ul style="list-style-type: none">- Birth data- Weight- Height- Blood type- Allergens
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	outpatient_care_f2
<i>Title</i>	Prescription of medication
<i>Type</i>	Functional
<i>Description</i>	Doctors can prescribe medication to patient. Patient can see their prescribed medication.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	outpatient_care_f3
<i>Title</i>	Write referral to hospital
<i>Type</i>	Functional
<i>Description</i>	Doctor can give referral to ward to patients.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	outpatient_care_f4
<i>Title</i>	Request for analysis in the lab
<i>Type</i>	Functional
<i>Description</i>	Doctors can give referral to analysis in the lab to patients.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	outpatient_care_f5
<i>Title</i>	Form lab analysis report
<i>Type</i>	Functional
<i>Description</i>	Lab employee can make lab tests which is not visible for patient, but visible to its doctor.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	outpatient_care_f6
<i>Title</i>	Form comprehensive appointment report
<i>Type</i>	Functional
<i>Description</i>	Doctor can make a comprehensive report according to the lab report. It can be added to patient's medical history and/or his/her notice Board.
<i>Priority</i>	1
<i>Risk</i>	Critical

D. Profiles

Functional

<i>ID</i>	profiles_f1
<i>Title</i>	Personal Hub web app for patients
<i>Type</i>	Functional
<i>Description</i>	Personal hub should be available to patients through official hospital's website.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	profiles_f2
<i>Title</i>	Personal Hub web app for medical personnel
<i>Type</i>	Functional
<i>Description</i>	Personal hub should be available to medical personnel through official hospital's website.
<i>Priority</i>	3
<i>Risk</i>	Critical

<i>ID</i>	profiles_f3
<i>Title</i>	Make an appointment
<i>Type</i>	Functional
<i>Description</i>	Patient should be able to make an appointment and assign to empty doctors timeslot.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	profiles_f4
<i>Title</i>	Timetable appointments view
<i>Type</i>	Functional
<i>Description</i>	Patients and doctors can see appointments that they are involved in.
<i>Priority</i>	1
<i>Risk</i>	Critical

<i>ID</i>	profiles_f5
<i>Title</i>	Patient Medical History access
<i>Type</i>	Functional
<i>Description</i>	Patients can see their Medical history in their profile.
<i>Priority</i>	1
<i>Risk</i>	High

<i>ID</i>	profiles_f6
<i>Title</i>	Patient Notice Board access
<i>Type</i>	Functional
<i>Description</i>	Patients can see upcoming events via Notice Board. Each patient has its own Notice Board.
<i>Priority</i>	1
<i>Risk</i>	High

<i>ID</i>	profiles_f7
<i>Title</i>	Notice Board notifications generation
<i>Type</i>	Functional
<i>Description</i>	Patient should get notification after each update in the Notice Board.
<i>Priority</i>	2
<i>Risk</i>	Medium

E. Ward system

Functional

ID	ward_f1
Title	Ward administrator rights
Type	Functional
Description	Administrator can put in a ward patient with referral to ward to a specific room. Administrator can move patient from a room to a room
Priority	1
Risk	Critical

ID	ward_f2
Title	Assigning a doctor to patient
Type	Functional
Description	<p>When patient is put to a ward, he is getting a doctor assigned to him. The doctor must provide a treatment plan for patients.</p> <p>Treatment plan should contain:</p> <ul style="list-style-type: none">• Medications, its frequency and quantity• Meal, its frequency and quantity• Diagnoses• Procedures• id
Priority	1
Risk	Critical

ID	ward_f3
Title	Nurses procedure performance
Type	Functional
Description	Nurses can check upcoming procedures on patients according to the treatment plans.
Priority	1
Risk	Critical

ID	ward_f4
Title	Ward patient discharge
Type	Functional
Description	Doctors can discharge patients from the hospital when the treatment is finished.
Priority	1
Risk	Critical

ID	ward_f5
Title	Ward room availability tracking
Type	Functional
Description	System should contain information about beds and rooms in the ward.
Priority	1
Risk	Critical

F. Inventory

Functional

ID	inventory_f1
Title	Inventory system tracking functionality
Type	Functional
Description	<p>There should be an inventory system which track an amount of medications and food left in stock and how much was used.</p> <p>Information that should be stored about medications and food:</p> <ul style="list-style-type: none">• id• name• supplier• Quantity_left• type (medication or food)• cost
Priority	1
Risk	Critical

ID	inventory_f2
Title	Inventory system access rights
Type	Functional
Description	Medical personnel can only check inventory system. Administrators can directly make changes to inventory system.
Priority	1
Risk	High

ID	inventory_f3
Title	Inventory system automated supplies tracking
Type	Functional
Description	The inventory system can be updated by the administrator according to the consumption of food and medications.
Priority	1
Risk	Medium

ID	inventory_f4
Title	Inventory system additional features
Type	Functional
Description	Inventory system should also track how much medication and food is going to be used by patients according to their treatment plans.
Priority	2
Risk	Low

G. Chat

Functional

ID	chat_f1
Title	Chat specification
Type	Functional
Description	The Healthcare Management System will support chat feature so that doctors and patients can communicate.
Priority	1
Risk	High

H. Payment

Functional

ID	payments_f1
Title	Payment multiple check out methods
Type	Functional
Description	Patients should be able to pay for treatment/consultation via bank card, cash or healthcare insurance.
Priority	1
Risk	Critical
ID	payments_f2
Title	Store receipt history of all payments
Type	Functional
Description	Patients and medical personnel should see the history of services and their respective costs.
Priority	2
Risk	Low
ID	payments_f3
Title	Final bill compilation of treatment
Type	Functional
Description	Compile single bill that can be paid at once from all services provided over the whole treatment period.
Priority	3
Risk	Low