Hospital Management System

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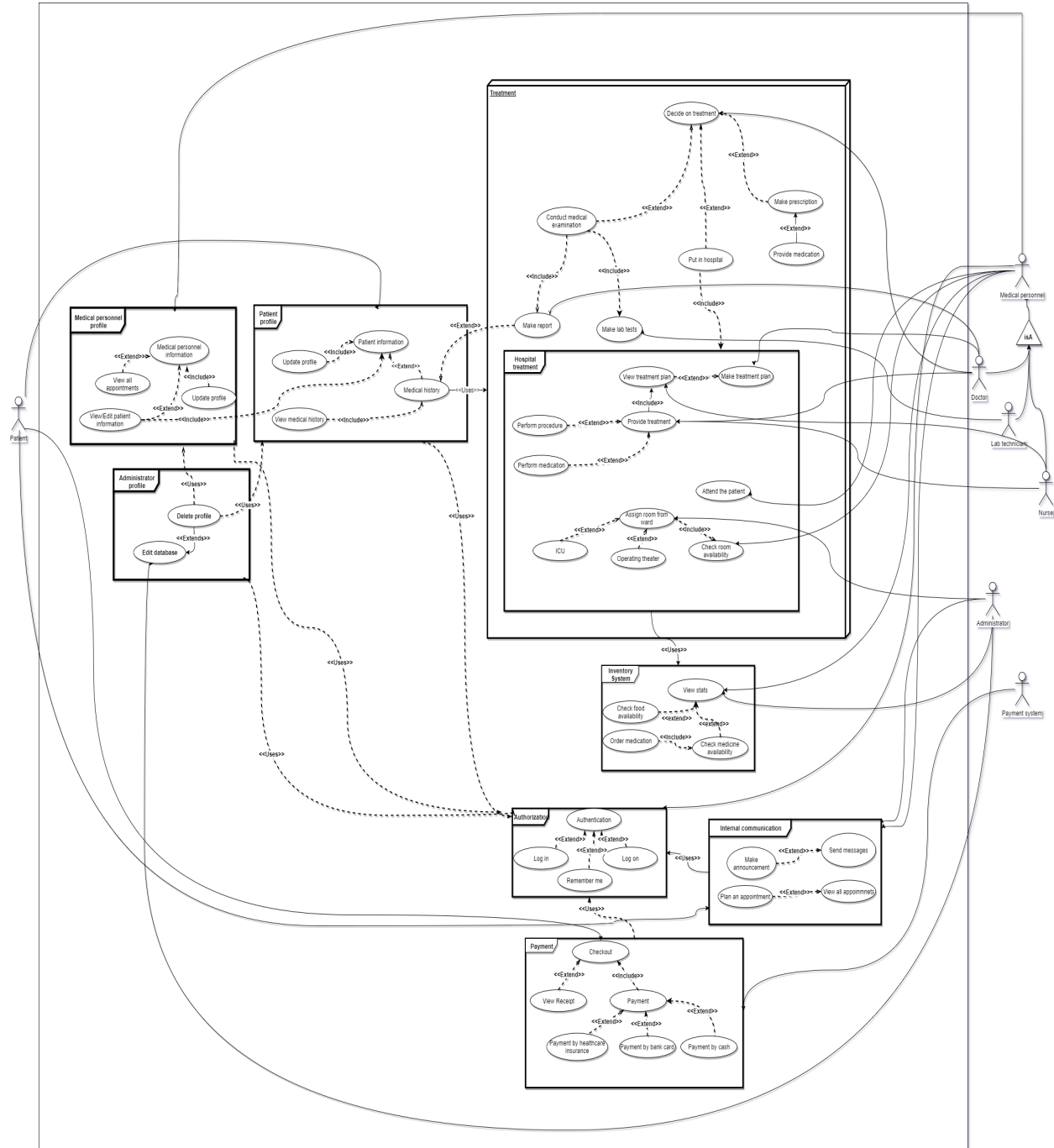**BS18-05**

Andrey Feygelman
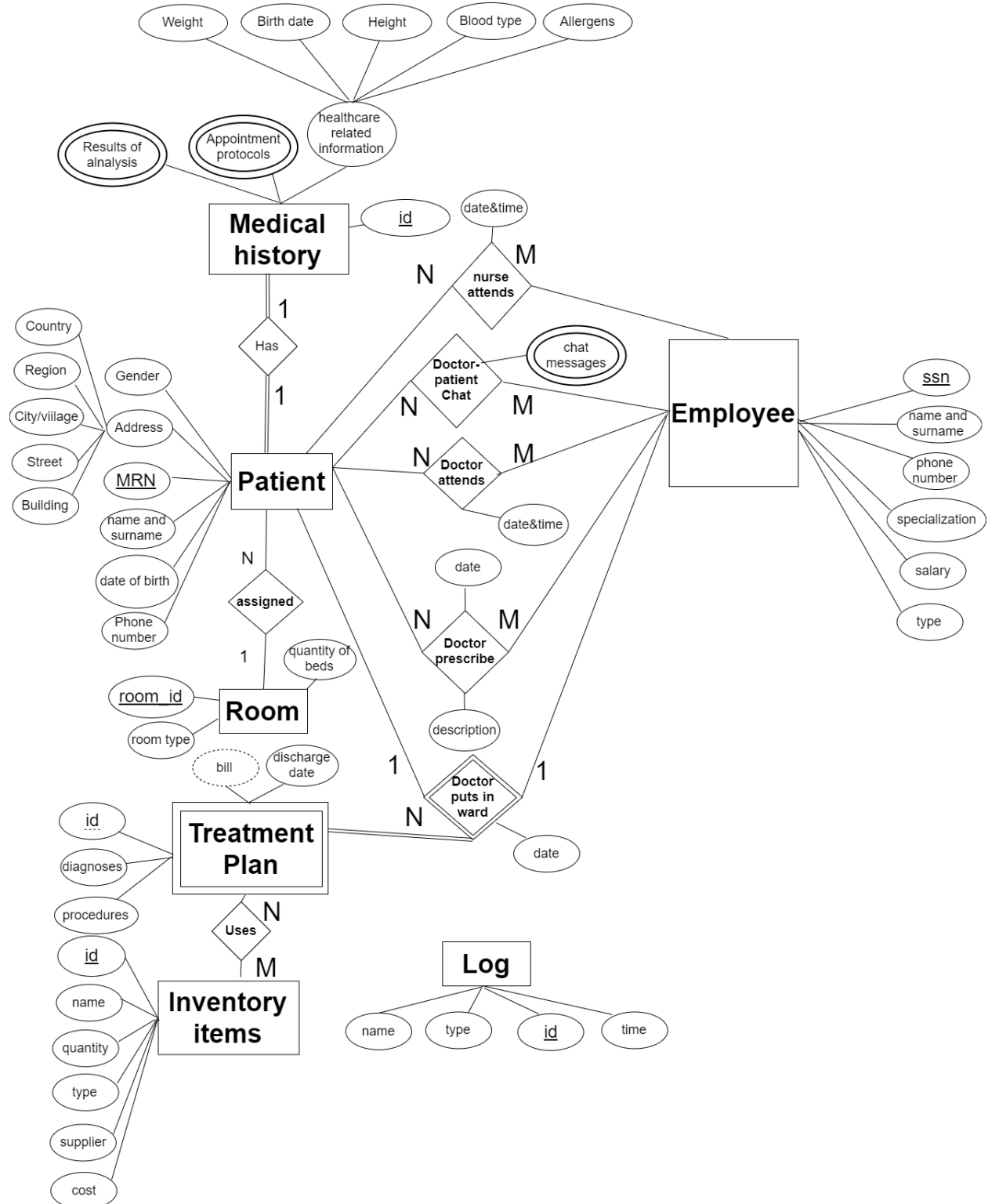**Ivan Abramov**
Magomed Magomedov

Table of content

I. Use case diagram

II. Entity-relationship model

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	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. 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.
Partial participation	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. 2) Employee partially participate in the relation «Doctor puts in ward» because not all employees participate in this relation.
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	1) Bill is a derived attribute because its value is calculated (derived) from other attributes. (Quantity and cost of Inventory items)
N to M relation	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.
One to one relation	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. 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.

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-word 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

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

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

Non-functional

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

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

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

ID	general_n4
Title	Support high patient load

Type	Non-functional
Description	System must be able to service a high number (a million) of concurrent users.
Priority	1
Risk	**High**

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

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

B. Authorization

Functional

ID	authorization_f1
Title	Patients registration and data
Type	Functional
Description	Patients can create account. Information that should be stored about patients: MRN name and surname address gender phone number medical history
Priority	1
Risk	**Critical**

ID	authorization_f2
Title	Medical personnel registration and data
Type	Functional
Description	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: ssn name and surname phone number specialization salary
Priority	1
Risk	**Critical**

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

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

C. Outpatient care

Functional

ID	outpatient_care_f1
Title	Doctor and patients medical history
Type	Functional

Description	Doctor can update their patient's medical history.
	Medical history should contain
	       Appointment protocols
	       Treatment plans
	       Medical data:
	            - Birth data
	            - Weight
	            - Height
	            - Blood type
	            - Allergens

Priority	1
Risk	**Critical**

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

ID	outpatient_care_f3

Title	Write referral to hospital
Type	Functional
Description	Doctor can give referral to ward to patients.
Priority	1
Risk	**Critical**

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

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

ID	outpatient_care_f6
Title	Form comprehensive appointment report

Type	Functional
Description	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.
Priority	1
Risk	**Critical**

D. Profiles

Functional

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

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

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

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

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

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

ID	profiles_f7

Title	Notice Board notifications generation
Type	Functional
Description	Patient should get notification after each update in the Notice Board.
Priority	2
Risk	**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	When patient is put to a ward, he is getting a doctor assigned to him. The doctor must provide a treatment plan for patients.
	Treatment plan should contain:
	    Medications, its frequency and quantity
	    Meal, is 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	There should be an inventory system which track an amount of medications and food left in stock and how much was used. Information that should be stored about medications and food: 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