DESIGN AND IMPLEMENTATION DOCUMENT

Hospital Data Management System

Abstract

Database system is an important element of an enterprise system. The hospital data management system is a case study of a mid-sized hospital prototype.

Introduction:

Database is a data repository of different records collected from an Information System (Source). Database systems must follow proper structure, planning, designing, and implementation methodology to produce a reliable and effective system.

The database systems project work is a prototype database system for Hospital Information/Data Management System. Implementing an advanced database will require a modification of the project strategies and procedures.

Project Statement:

The key agenda of any project to identify the problem and provide a solution using structured project work

Manual record management system operations are both operationally and financially costly when it comes to managing client records:

- The manual record management system cannot give us a proper understanding of the healthcare service consumer base.
- Data and information are not adequately protected.
- There is a possibility that the patient data and information may be exposed for unauthorized modifications.
- Maintaining a manual record-keeping system might be too onerous.
- Data access is insufficiently controlled.

Implementation Objectives:

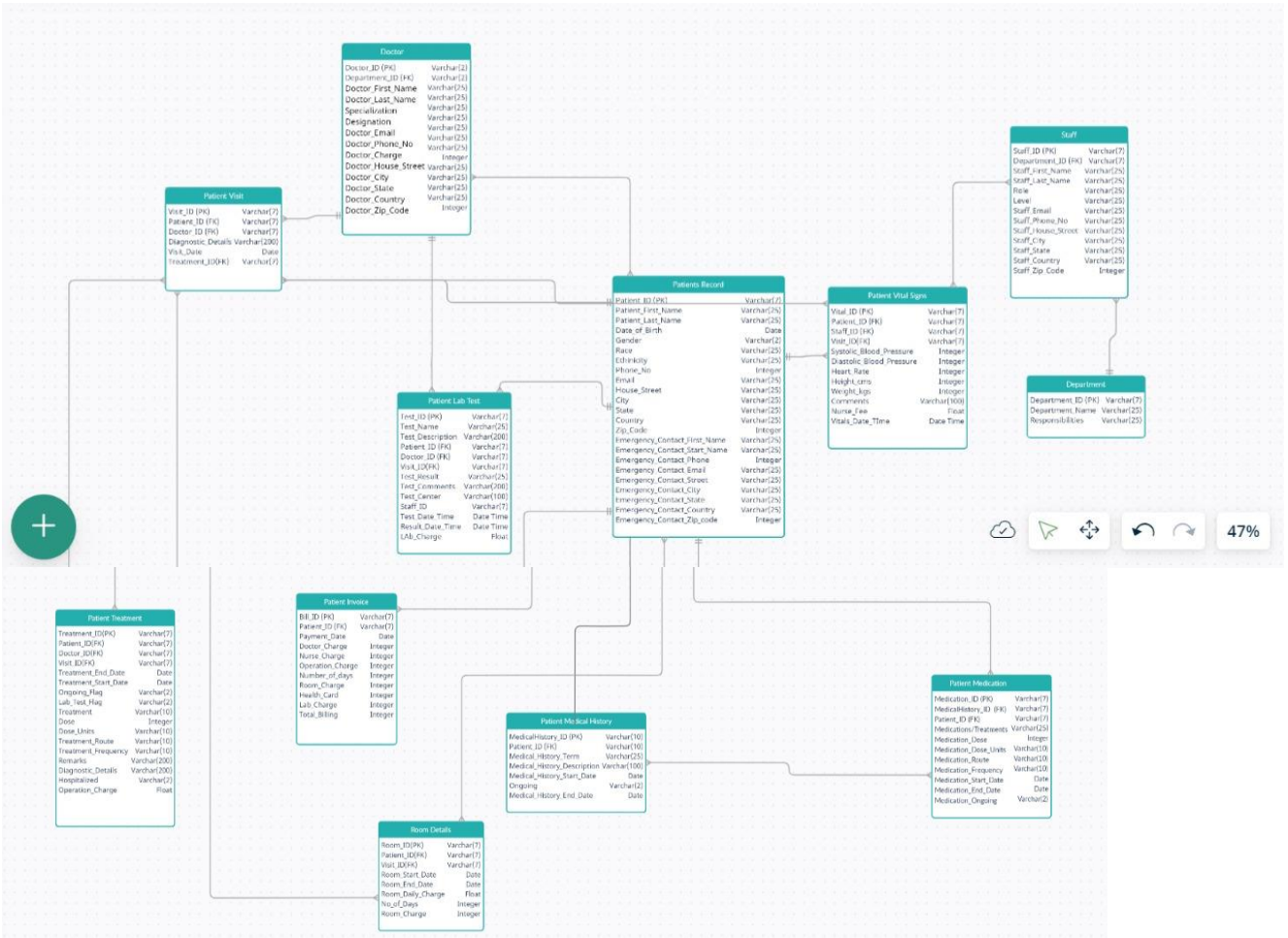
- We must guarantee that patient data is acquired correctly, processed effectively, securely kept, and retrievable by authorized users for operational purposes.
- The database will make client records available in real-time so that services may be provided to them.
- Structure of the database is simple and easy to filter the data
- System administrator will be given privileges to handle the accounts and permissions for the view
- Patient's data is stored in different levels and can be accessed by the "Patient_ID"
- The doctor will be able to access patient's medical records but not personal information.
- The patient information will be updated from time to time based on his visits
- There is a department which has different departments and different roles
- There is a doctor table which consists of doctors, department ID, managed by, specializations
- The other staff members are kept in Staff table which as similar layout to that of Doctor's tables
- Patient Invoice consists of all the billing activities of the patient during different visits

Proposed Solution:

To overcome the above problems, a model can be used. The issues are resolved as follows.

- To avoid cluttering we have divided the patient data into tables interlinked using the primary and foreign keys for integrity and uniqueness of data.
- Using the database design, the doctor can access the records of patients such as Patient Vital Signs, Patient Lab tests, Patient Medication and Patient Medical History without disclosing the patient personal information. This guarantees data security.
- All the patient billings records can be shown in one table that is ‘Patient_Invoice’ entity rather than creating separate tables for different entities.
- The database contains staff entity that includes the records of the other staff in the hospital excluding doctors for instance nurse, reception, department with respective ‘Staff_Id’ as primary and ‘Department_Id’ as foreign key.

Data Model E-R Diagram:



Tables

Patients Record Entity

Attributes	Description	Data type	Relationship
Patient_ID	Patient Identification Number	Varchar(10)	Primary Key
Patient_First_Name	Patient First Name	Varchar(25)	Not Null
Patient_Last_Name	Patient Last Name	Varchar(25)	Not Null
Date_of_Birth	Patient Date of Birth	Date	Not Null
Gender	Patient Gender	Varchar(2)	Not Null
Race	Patient Race	Varchar(25)	Not Null
Ethnicity	Patient Ethnicity	Varchar(25)	Not Null
Phone_No	Patient Phone Number	Integer	Not Null
Email	Patient Email	Varchar(25)	Not Null
House_Street	Patient House Number and Street	Varchar(25)	Not Null
City	City where Patient resides	Varchar(25)	Not Null
State	State where Patient resides	Varchar(25)	Not Null
Country	Country where Patient resides	Varchar(25)	Not Null
Zip_Code	Zip code where Patient resides	Integer	Not Null
Emergency_Contact_First_Name	Emergency Contact First Name	Varchar(25)	Not Null
Emergency_Contact_Start_Name	Emergency Contact Last Name	Varchar(25)	Not Null
Emergency_Contact_Phone	Emergency Contact Phone Number	Integer	Not Null
Emergency_Contact_Email	Emergency Contact Email	Varchar(25)	Not Null
Emergency_Contact_Street	Emergency Contact House Number and Street	Varchar(25)	Not Null
Emergency_Contact_City	Emergency Contact City	Varchar(25)	Not Null
Emergency_Contact_State	Emergency Contact State	Varchar(25)	Not Null
Emergency_Contact_Country	Emergency Contact Country	Varchar(25)	Not Null
Emergency_Contact_Zip_code	Emergency Contact Zip code	Integer	Not Null

Patient Vital Signs Entity

Attributes	Description	Data type	Relationship
Vital_ID	Vitals Identification Number	Varchar(10)	Primary Key

Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Staff_ID	Nurse Identification Number	Varchar(10)	Foreign Key
Visit_ID	Visit Identifier	Varchar(10)	Foreign Key
Systolic_Blood_Pressure	Patient systolic Blood Pressure	Integer	Not Null
Diastolic_Blood_Pressure	Patient diastolic Blood Pressure	Integer	Not Null
Heart_Rate	Patient Heart Rate	Integer	Not Null
Height_cms	Patient Height	Integer	Not Null
Weight_kgs	Patient Weight	Integer	Not Null
Comments	Nurse Comments	Varchar(100)	Not Null
Nurse_Fee	Check-up fees	Float	Not Null
Vitals_Date_Time	Vitals Test Date	Date Time	Not Null

Patient Lab Test Entity

Attributes	Description	Data type	Relationship
Test_ID	Test Identification Number	Varchar(10)	Primary Key
Test_Name	Test Name	Varchar(25)	Not Null
Test_Description	Test Description	Varchar(200)	Not Null
Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Doctor_ID	Doctor Identification Number	Varchar(10)	Foreign Key
Visit_ID	Visit Identifier	Varchar(10)	Foreign Key
Test_Result	Test Result	Varchar(25)	Not Null
Test_Comments	Test Comments	Varchar(200)	Not Null
Test_Center	Lab Diagnostic Centre	Varchar(100)	Not Null
Staff_ID	Lab Staff Identification Number	Integer	Foreign Key
Test_Date_Time	Lab Test Date	Date Time	Not Null
Result_Date_Time	Lab Result Date	Date Time	Not Null
Lab_Charge	Check up fees	Float	Not Null

Patient Treatment

Attributes	Description	Data type	Relationship
Treatment_ID	Treatment Identifier	Varchar(10)	Primary Key
Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Doctor_ID	Doctor Identification Number	Varchar(10)	Foreign Key
Visit_ID	Visit Identifier	Varchar(10)	Foreign Key
Treatment_End_Date	Patient Treatment End Date	Date	Null
Treatment_Start_Date	Patient Treatment Start Date	Date	Not Null
Ongoing_Flag	Lab Test Required	Varchar(2)	Null
Lab_Test_Flag	Lab Test Required	Varchar(2)	Null
Treatment	Treatments/Medication Prescribed	Varchar(10)	Null
Dose	Prescribed Medication Dose	Integer	Null
Dose_Units	Prescribed Medication Dose Units	Varchar(10)	Null
Treatment_Route	Prescribed Medication Dose	Varchar(10)	Null

	Route		
Treatment_Frequency	Treatment Frequency	Varchar(10)	Null
Remarks	Doctor Remarks	Varchar(200)	Null
Diagnostic_Details	Patient Diagnosis Details	Varchar(200)	Not Null
Hospitalized	Patient Hospitalized	Varchar(2)	Null
Operation_Charge	Operation fees	Float	Not Null

Room Details

Attributes	Description	Data type	Relationship
Room_ID	Visit Identifier	Varchar(10)	Primary Key
Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Visit_ID	Visit Identifier	Varchar(10)	Foreign Key
Room_Start_Date	Patient Room Start Date	Date	Not Null
Room_End_Date	Patient Room End Date	Date	Null
Room_Daily_Charge	Room fees per day	Float	Not Null
No_of_Days	Total Stay	Integer	Not Null
Room_Charge	Room fees	Float	Null

Patient Visit Entity

Attributes	Description	Data type	Relationship
Visit_ID	Visit Identifier	Varchar(10)	Primary Key
Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Doctor_ID	Doctor Identification Number	Varchar(10)	Foreign Key
Diagnostic_Details	Patient Diagnosis Details	Varchar(200)	Not Null
Visit_Date	Patient Visit Date	Date	Not Null

Patient Medical History Entity

Attributes	Description	Data type	Relationship
MedicalHistory_ID	Medical History Identification Number	Varchar(10)	Primary Key
Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Medical_History_Term	Medical History Term	Varchar(25)	Not Null
Medical_History_Description	Medical History Description	Varchar(100)	Not Null
Medical_History_Start_Date	Medical History Start Date	Date	Not Null
Ongoing	Ongoing	Varchar(2)	Null
Medical_History_End_Date	Medical History End Date	Date	Null

Patient Medication Entity

Attributes	Description	Data type	Relationship

Medication_ID	Medication/Treatment Identification Number	Varchar(10)	Primary Key
MedicalHistory_ID	Medical History Identification Number	Varchar(10)	Foreign Key/Null
Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Medications/Treatments	Treatments/Medication Patient is under going	Varchar(25)	Not Null
Medication_Dose	Dose of Medication	Integer	Null
Medication_Dose_Units	Units of Dose	Varchar(10)	Null
Medication_Route	Route taken for medication	Varchar(10)	Null
Medication_Frequency	Invervals of medication/treatment	Varchar(10)	Null
Medication_Start_Date	Medication Start Date	Date	Not Null
Medication_End_Date	Medication End Date	Date	Null
Medication_Ongoing	If medication is ongoing	Varchar(2)	Null

Doctor Entity

Attributes	Description	Data type	Relationship
Doctor_ID	Doctor Identification Number	Varchar(10)	Primary Key
Department_ID	Department Identification Number	Varchar(10)	Foreign Key
Doctor_First_Name	Doctor First Name	Varchar(25)	Not Null
Doctor_Last_Name	Doctor Last Name	Varchar(25)	Not Null
Specialization	Doctor Specialization	Varchar(25)	Not Null
Designation	Doctor Designation	Varchar(25)	Not Null
Doctor_Email	Doctor Email	Varchar(25)	Not Null
Doctor_Phone_No	Doctor Phone Number	Varchar(25)	Not Null
Doctor_Charge	Doctor Charge	Float	Not null
Doctor_House_Street	Doctor House Number and Street	Varchar(25)	Not Null
Doctor_City	City where Doctor resides	Varchar(25)	Not Null
Doctor_State	State where Doctor resides	Varchar(25)	Not Null
Doctor_Country	Country where Doctor resides	Varchar(25)	Not Null
Doctor_Zip_Code	Zipcode where Doctor resides	Integer	Not Null

Department Entity

Attributes	Description	Data type	Relationship
Department_ID	Department Identification Number	Varchar(10)	Primary Key
Department_Name	Department Name	Varchar(25)	Not Null
Responsibilities	Department Responsibilities	Varchar(25)	Not Null

Staff Entity

Attributes	Description	Data type	Relationship
Staff_ID	Staff Identification Number	Varchar(10)	Primary Key
Department_ID	Department Identification Number	Varchar(10)	Foreign Key
Staff_First_Name	Staff First Name	Varchar(25)	Not Null
Staff_Last_Name	Staff Last Name	Varchar(25)	Not Null
Role	Role	Varchar(25)	Not Null
Level	Staff level/ Ranks	Varchar(25)	Not Null
Staff_Email	Staff Email	Varchar(25)	Not Null
Staff_Phone_No	Doctor Phone Number	Varchar(25)	Not Null
Staff_House_Street	Staff House Number and Street	Varchar(25)	Not Null
Staff_City	City where Staff resides	Varchar(25)	Not Null
Staff_State	State where Staff resides	Varchar(25)	Not Null
Staff_Country	Country where Staff resides	Varchar(25)	Not Null
Staff_Zip_Code	Zipcode where Staff resides	Integer	Not Null

Patient Invoice Entity

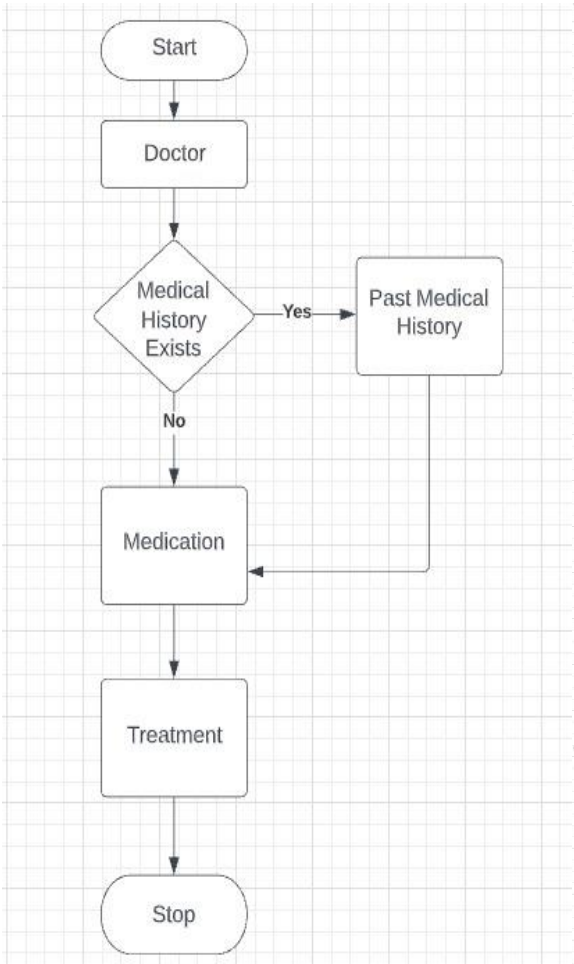
Attributes	Description	Data type	Relationship
Bill_ID	Invoice Identification Number	Varchar(10)	Primary Key
Patient_ID	Patient Identification Number	Varchar(10)	Foreign Key
Payment_Date	Date of Payment	Date	Not null
Doctor_Charge	Doctor Charge	Float	Not null
Nurse_Charge	Nurse Charge	Integer	Not null
Operation_Charge	Operation Charge	Integer	Null
Number_of_days	Number of Days	Integer	Null
Room_Charge	Room Charge	Integer	Null
Health_Card	Health Card	Integer	Null
Lab_Charge	Lab Charge	Integer	Null
Total_Billing	Total Billing	Integer	Not null

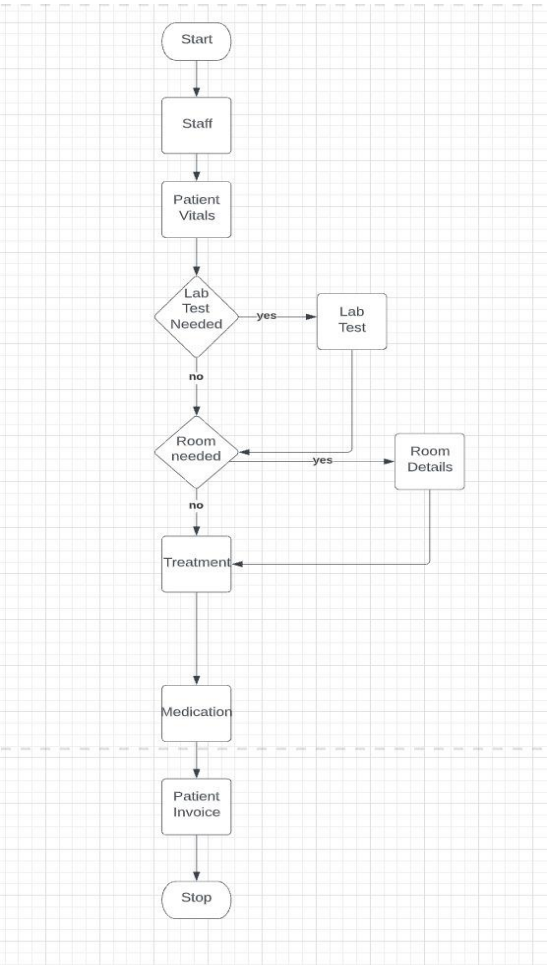
Paid	Bill Paid	Varchar(2)	Not null

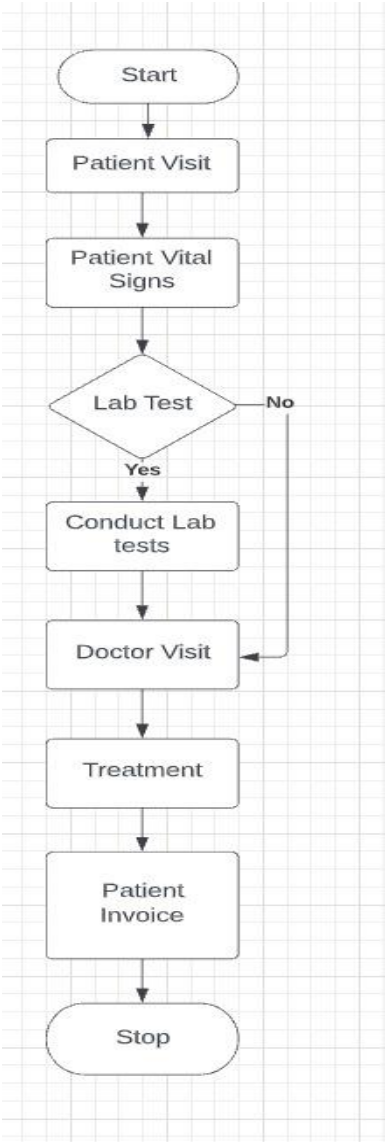
Admin Entity

Attributes	Description	Data type	Relationship
ID	Admin Identification Number	Varchchar(10)	Primary Key

Data Flow Diagrams:







THESE DATA FLOW DIAGRAMS SHOW

1. The process of patient, doctor and staff onboarding.
2. How to access a patient's medical history.
3. How the patient invoicing and billing works

BUSINESS RULES:

General Rules:

1) The contact numbers should be 10 digits
2) The Start and End dates should not be future dates
3) The End date should not be before Start Date
4) The Email should follow proper format REGEXP_LIKE (Email, '[A-Z0-9._%+-]+@[A-Z0-9.-]+\.[A-Z]{2,4}', 'i')

Patient Table:

1) All the required details of the patient should be filled correctly
2) The PATIENT can only register once. The PATIENT should not have multiple records assigned to him.

Patient Lab Test Table:

1) DOCTOR will provide a LAB TESTS required for the PATIENT.
2) A PATIENT can have multiple lab tests per visit but the LAB TEST ID will change for individual test
3) The NURSE fee is generated for individual LAB TEST

Patient Treatment Table:

1) If the Treatment is Ongoing then End Date should be null
2) If the Treatment End Date is generated then Ongoing should be null
3) If the LAB test is Y, then the LAB CHARGE is generated
4) If the Patient is hospitalized then operated then Operation Charge is generated

Room Details:

1) ROOM CHARGE is generated based on number of days
2) The ROOM daily charge is fixed price

Patient Visit:

1) PATIENT should have single visit per day

Medical History Table:

1) The PATIENT MEDICAL HISTORY consists of all the details regarding the previous medications of the patient.
2) The MEDICAL HISTORY DESCRIPTION contains the information of the prior medical information, like the problems the patient was facing.
3) ONGOING is flagged either Y or N. If the treatment is completed, ONGOING is marked N, else it is marked Y.
4) The MEDICAL HISTORY END DATE has a value only if the treatment is finished that is, if ONGOING is N. If ONGOING is Y, MEDICAL HISTORY END DATE will be NULL.

Medication Table:

1) The PATIENT MEDICATION table also consists of MEDICAL HISTORY ID and PATIENT ID.
2) MEDICATIONS/TREATMENTS stores all the details of treatment the patient is currently undergoing.
3) MEDICATION DOSE stores an integer value like 5, 10, or 650,250, based on the units.
4) MEDICATION DOSE UNITS is used to store the units for the dosage based on weight (in mg) or volume (in mL or drops).
5) MEDICATION ROUTE is the way the medicine enters the body of the patient. It can be ORAL or through INJ (for injection).
6) MEDICATION FREQUENCY describes when the medicine needs to be taken. It is identified as D2-M/E, if it is prescribed as Morning and Evening, twice a day and as W3, if it is thrice a week.
7) MEDICATION ONGOING is flagged Y if the treatment is continuing. It is flagged N if the treatment has ended.
8) MEDICATION END DATE is NULL if the MEDICATION ONGOING is flagged Y. If it is flagged N, then MEDICATION END DATE stores the finish date of the treatment.

Department Table:

1) There are 2 departments: DOCTOR and STAFF
2) The ID's: DEPD-101 is for DOCTORS and DEPS-102 is for STAFF

Doctor Table:

1) PATIENT is Assigned to a DOCTOR
2) DOCTOR can see the PATIENT MEDICATION and MEDICAL HISTORY of the Patient
3) The DOCTORS have different specialization
4) Designation is the level of the DOCTOR

Staff Table:

1) STAFF is part of hospital management
2) STAFF consists of IDs of all the Hospital Staff other than the DOCTOR
3) NURSES and LAB ASSITANTS come under STAFF for the current data model
4) The STAFF IDs are divided into 2 types 'LAB-XXXXX' and 'NUR-XXXXX'
5) The STAFF table is similar to DOCTOR table. Included 'Level' just like specializations for DOCTOR

Patient Invoice Table:

1) The PATIENT INVOICE contains all the billing details with respect to the patients.
2) OPERATION CHARGE is taken from PATIENT TREATMENT table, DOCTOR CHARGE is taken from the DOCTOR table, ROOM CHARGE is taken from ROOM

DETAILS table, NURSE FEE is taken from PATIENT VITALS table and LAB CHARGE is taken from PATIENT LAB TESTS table.

3) HEALTH CARD details are given by the PATIENTS during billing
4) TOTAL BILLING is sum of APPOINTMENT CHARGE, OPERATION CHARGE, DOCTOR CHARGE, ROOM CHARGE, NURSE FEE, LAB CHARGE minus HEALTH CARD amount.
5) APPOINTMENT CHARGE is a default charge

Administration Table:

1) ADMISTRATION TABLE is managed by the ADMIN is consist of all the users IDs.

Views:

Patient views:

1. Read, write and update all attributes in the patient record table.
2. Read all the attributes in the tables of Patient Vital Signs, Patient Lab Test, Patient Treatment, Room Details, Patient Visit, Medical History, Patient Medication, Patient Invoice.

Doctor View:

1. Read all the attributes in the tables of Patient Vital Signs, Patient Lab Test, Room Details and Patient Medical History.
2. Read, Write and Update Patient Lab Test (Test ID, Test Name, Test Description only), and all attributes in the tables of Patient Treatment, Patient Medication and Doctor.

Staff View:

There are 3 types of staff with different staff id's to differentiate between the staff personnel.

Lab Assistant View:

1. Write all the attributes in the table of Patient Lab Test table.
2. Read all the attributes in the table of Patient Lab Test (Test ID, Test Name, Test Description only)

Nurse View:

1. Write all the attributes in the table of Patient Vital Signs.
2. Read all the attributes in the tables of Room Details, Patient Visit, Patient Medication.
3. Read Write and Update all the attributes in the table of Patient Treatment.

Receptionist View:

1. Read, Write, and Update all the attributes in the table of Patient Record, Room Details, Patient Visit, Doctor, Department, Staff id, Patient Invoice tables.

Admin View:

1. ADMIN can read, write and update all the attributes in all the tables.

SECURITY RULES:

Admin:

Has full access to all entities in the database.
Create, view and update all attributes in all tables.

Patient:

Doesn't have access to department, doctor and staff tables.

Doctor:

Don’t have access to patient, staff and department personal information in those tables.

Staff:

Nurse: Don’t have access to patient record, doctor, staff and department information (except for their own information).

Lab assistant: Don’t have access to any tables except for patient lab test and staff table (of their own information only).

Receptionist: Don’t have access to patient lab test, patient vital signs, patient treatment table.