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PROJECT – 1

A Database For An Electronic Medical Record System

Introduction:

An electronic medical record (EMR) is a digital version of all the information about a hospital or clinic such as medical history, diagnoses, medications, appointment dates, treatment, allergies, lab results and doctor's notes. EMRs are more than just a replacement for paper records. They effectively allow communication and coordination among members of a healthcare team for optimal patient care.

In this project, I have developed a database system for Royale Baby Children's Clinic. It is named as royale_baby_clinic. This database has been created to get an overview of this small practice of children's clinic. It is designed to manage clinic related information such as patient's information, medical records, record keeping of doctor's status and pharmacy inventory.

Database Design Overview:

The clinic keeps track of patients, employees, appointments, pharmacy, medical bills as well as test procedures.

A textual description of user requirements is briefly outlined below:

1. Patients are identified by patient_id, firstname, lastname, age and gender along with their insurance id.

   patient_info(patient_id,First_Name,Middle_Name,Last_Name,Gender,Age,Phone_number,Address,Insurance_id,pcp)

2. Employees are identified as employee_id, firstname, lastname, designation and salary.

   clinic_employee(employee_id,First_Name,Last_Name,Designation,Salary)

3. Appointment for each patient is mainly identified using appointment_id, patient_id as well as doctor_id and nurse_id who treats them including date and the room where the patient is treated.

   appointment_info(appointment_id,patient_id,nurse_id,doctor_id,start_datetime,end_datetime,room_number)

4. The treatment rooms at clinic identified using room id and room number.

   clinic_treatment_room(room_number,room_type)

5. Each medical bill at the clinic has bill id, appointment id, total cost and date.

   bill(bill_id,appointment_id,total_cost,date_)

6. Medical insurance of a patient has insurance id, insurance provider, policy number, type of insurance plan, start date and end date.

   health_insurance(insurance_id,insurance_provider,policy_no,plan_type,start_date,end_date)

7. Medical prescription for a patient contains appointment id, medicine id and medicine dose.

   medical_prescription(appointment_id,medicine_id,medicine_code)

8. Procedures that patients undergo are identified by procedure number, appointment id, procedure id, date, doctor id and nurse id.

   patient_procedure(procedure_no,appointment_id,procedure_id,date_,doctor_id,nurse_id)

9. Patient symptoms are identified using appointment id and few common symptoms.

   patient_symptoms(appointment_id,fever,flu,ear_infection,stomach_pain,pneumonia,tooth_pain)

10. Pharmacy inventory is identified using medicine id, medicine name, supplier, description and price per item.

    pharmacy_inventory(medicine_id,medicine_name,supplier,description,price_per_item)

11. Procedure results are identified by procedure_id, results and summary.

    procedure_results(procedure_id,results,summary)

12. The test procedures available at clinic are identified by id, name, description and price.

    test_procedure(id,name,description,price)

In this database, we have a total of 12 tables:

1. **appointment_info** : This table contains information about all appointments that are taken by the patients at the clinic. This table provides information about the patient, the doctor, and the nurse who will be caring for the patient on a specific appointment day and time. Additionally, for that specific patient, the room _number is mentioned. The key, which serves as a patient reference in other tables, is appointment_id. A patient may schedule multiple appointments. And also, a doctor and nurse can provide treatment for multiple appointments.

Field	Type	Null	Key	Other
appointment_id	Int	No	Primary	Auto Increment
patient_id	Int	No		
nurse_id	Int	No		
doctor_id	Int	No		
start_datetime	Datetime	No		
end_datetime	Datetime	No		
room_number	Int	No		

2. **bill:** This table provides information about patient's billing which is identified by bill_id and this is a primary key and the bill is referenced by appointment_id. Each appointment can have multiple bills.

Field	Type	Null	Key	Other
bill_id	Int	No	Primary	Auto Increment
appointment_id	Int	No		
total_cost	decimal	No		
date_	datetime	No		

3. **clinic_employee**: This table contains information about all the employees working for the clinic. It provides employee_id, firstname, lastname, designation and salary of an employee. Here, employee_id acts as a primary key.

Field	Type	Null	Key
Employee_id	int	No	Primary
First_Name	varchar	No	
Last_Name	varchar	No	
Designation	varchar	No	
Salary	decimal	No	

4. **clinic_treatment_room**: This table provides information about the treatment rooms with room_number which is a primary key here and room_type.

Field	Type	Null	Key
room_number	int	No	Primary
room_type	varchar	No	

5. **health_insurance**: This table provides insurance details of a patient who visited the clinic. It contains data such as insurance_id, insurance_provider,policy_no,plan_type, start_date and end_date and insurance for a patient is uniquely identified by insurance_id which is used as a reference or acts as a reference in the patient's table.

Field	Type	Null	Key
insurance_id	int	No	Primary
insurance_provider	varchar	No	
policy_no	varchar	No	
plan_type	varchar	No	
start_date	datetime	No	
end_date	datetime	No	

6. **medical_prescription**: This table is used to identify the medication given to the patient. It contains information about appointment_id, medicine_code and medicine_dose. Here, appointment_id and medicine_code together acts as a primary key. Also, a patient may be given many medicines.

Field	Type	Null	Key
appointment_id	int	No	Primary
medicine_code	varchar	No	Primary
medicine_dose	int	No	

7. **patient_info**: This table contains all the information about the patient visiting the clinic including patient_id, firstname, middlename, lastname, insurance_id, gender, age, phone number and primay care provider. Here, patient_id acts as primary key. The insurance_id here acts as a reference to the health_insurance table.

Field	Type	Null	Key
patient_id	int	No	Primary
First_Name	varchar	No	
Middle_Name	varchar	Can be null	
Last_Name	varchar	No	
insurance_id	int	No	
Gender	varchar	No	
Age	int	No	
Phone_number	int	No	
Address	varchar	No	
pcp	varchar	No	

8. **patient_procedure:** This table includes information about the procedures and examinations that were done on the particular patient. Procedures may or may not be performed on a patient. A patient could experience several procedures. Through appointment_id, the procedures are associated with the patient. Doctor_id and u nurse_id columns are also present in this database since the doctor and nurse doing the treatment may change depending on the patient. Doctors and nurses may perform multiple procedures on a single or more patients.

Field	Type	Null	Key
procedure_no	int	No	
appointment_id	int	No	Primary
procedure_id	int	Can be null	Primary
date_	datetime	No	
doctor_id	int	No	
nurse_id	int	No	

9. **patient_symptoms**: This table contains information about a patient who is displaying symptoms. Common symptoms are listed as columns with a TINYINT type of 0 for false and 1 for true. The symptoms are connected to appointment_id, which is connected to the patient. A patient may encounter a variety of symptoms while at the clinic. This is a one-on-one connection because the patient must disclose all relevant information regarding his symptoms at each appointment.

Field	Type	Null	Key
appointment_id	int	No	Unique
fever	Tinyint	No	
flu	Tinyint	No	
toothpain	Tinyint	No	
ear_infection	Tinyint	No	
stomach_pain	Tinyint	No	
penumonia	tinyint	No	

10. **pharmacy_inventory**: This table provides information about the medicines available in the clinic.

Field	Type	Null	Key
medicine_id	int	No	Primary
medicine_name	Varchar	No	
supplier	Varchar	No	
description	Varchar	Can be null	
price_per_item	decimal	No	

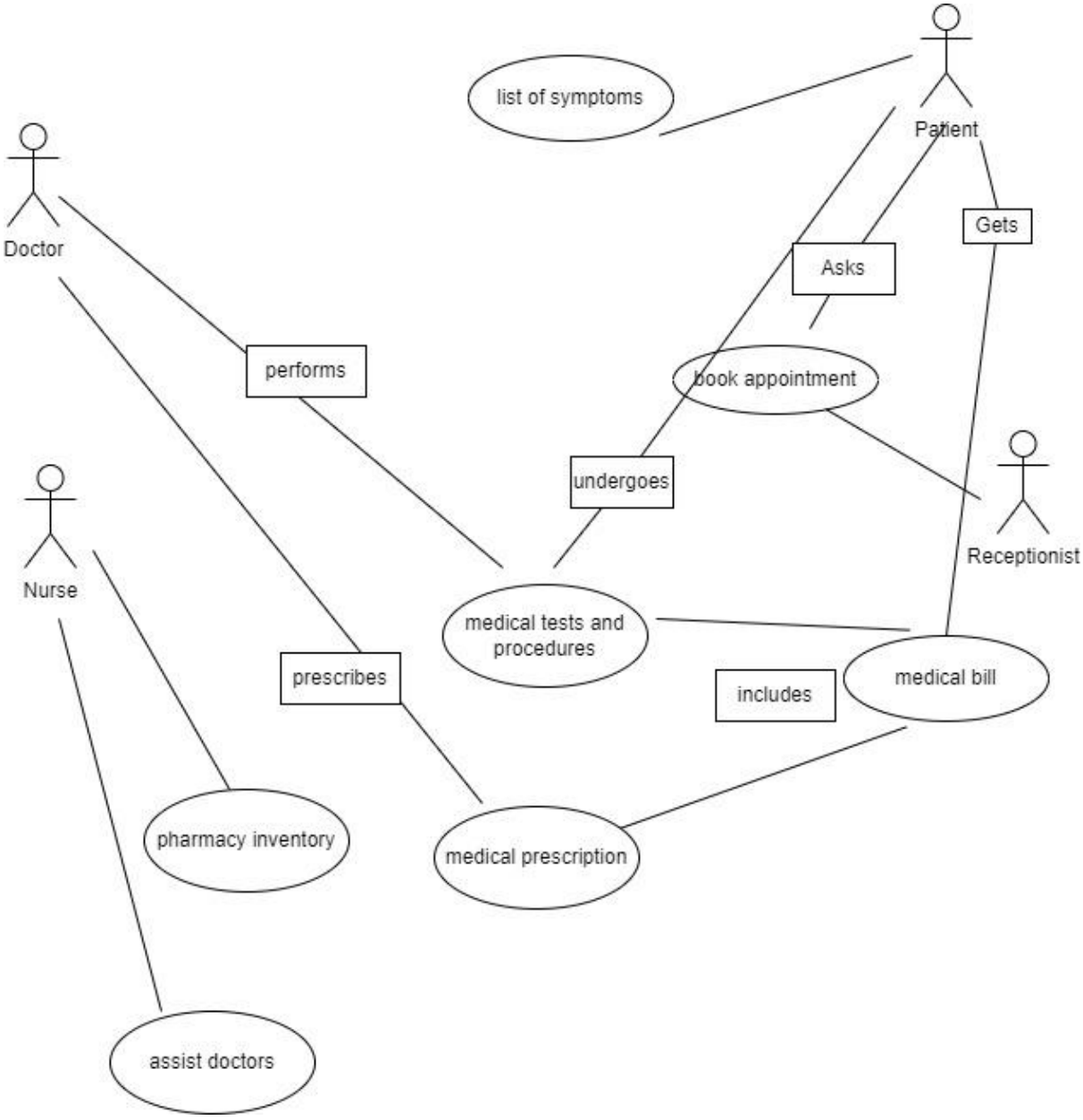
11. **procedure_results**: This table gives information about the final results of the procedure that a patient has undertaken. These procedure results are connected to patient_procudure though procedure_id which is further connected to patient through appointment_id.

Field	Type	Null	Key
procedure_id	int	No	Foreign
results	varchar	No	
summary	varchar	Can be null	

12. **test_procedure**: This table provides information about the procedures that are available in the clinic.

Field	Type	Null	Key
id	int	No	Primary
name	Varchar	No	
description	Varchar	No	
price	Varchar	No	

Below here attached a use case diagram of the design to get a better understanding of the interaction between users and the database system.



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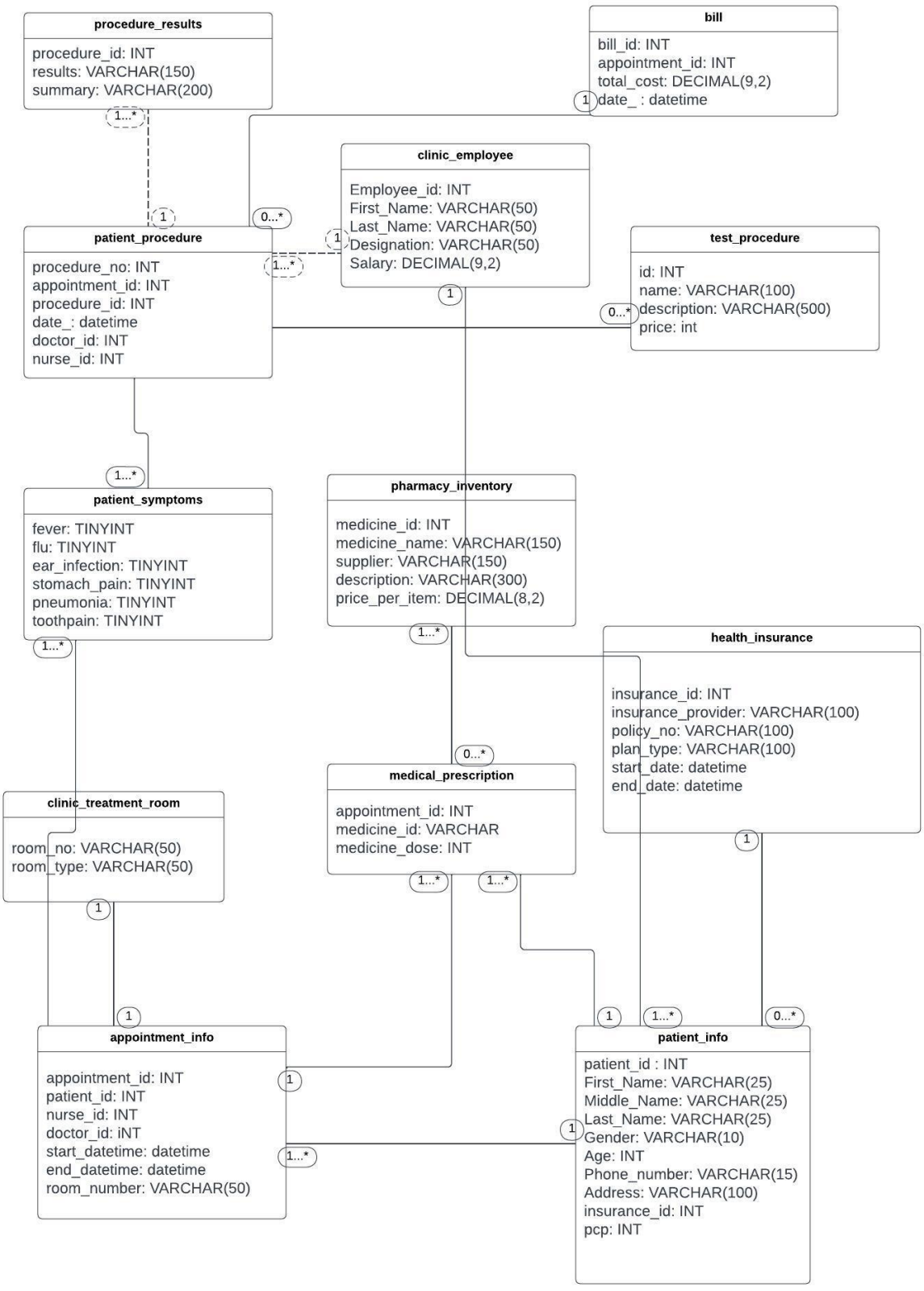
UML Diagram:



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We have 12 tables in the database. Based on the design, we have multiple relationships among the tables in the database. UML diagram is used as a way to visualize a project before it takes place. Here is a rough diagram of the database. As we could see there are 12 tables for the database.

Some important relationships among the tables are as follows:

1. A doctor can treat many patients.
2. A patient can be treated by only one doctor at once.
3. A patient can have only one health insurance.
4. But a health insurance type is taken by many patients.
5. A patient can have multiple appointments.
6. Each appointment can have only one patient at once.
7. A patient can have multiple symptoms.
8. A patient can under zero or more tests or procedures.
9. Each procedure can be undergone by zero or more patients.
10. Each doctor can perform more than one procedure.

ER diagram:

Entity Relationship diagram provides visual representation of the relationships among the tables in the database model.

Below here is the ER diagram of the royale_baby_clinic which clearly depicts the relationships among the tables including multiplicity.

In this diagram, yellow color indicates primary key whereas red indicates foreign key.

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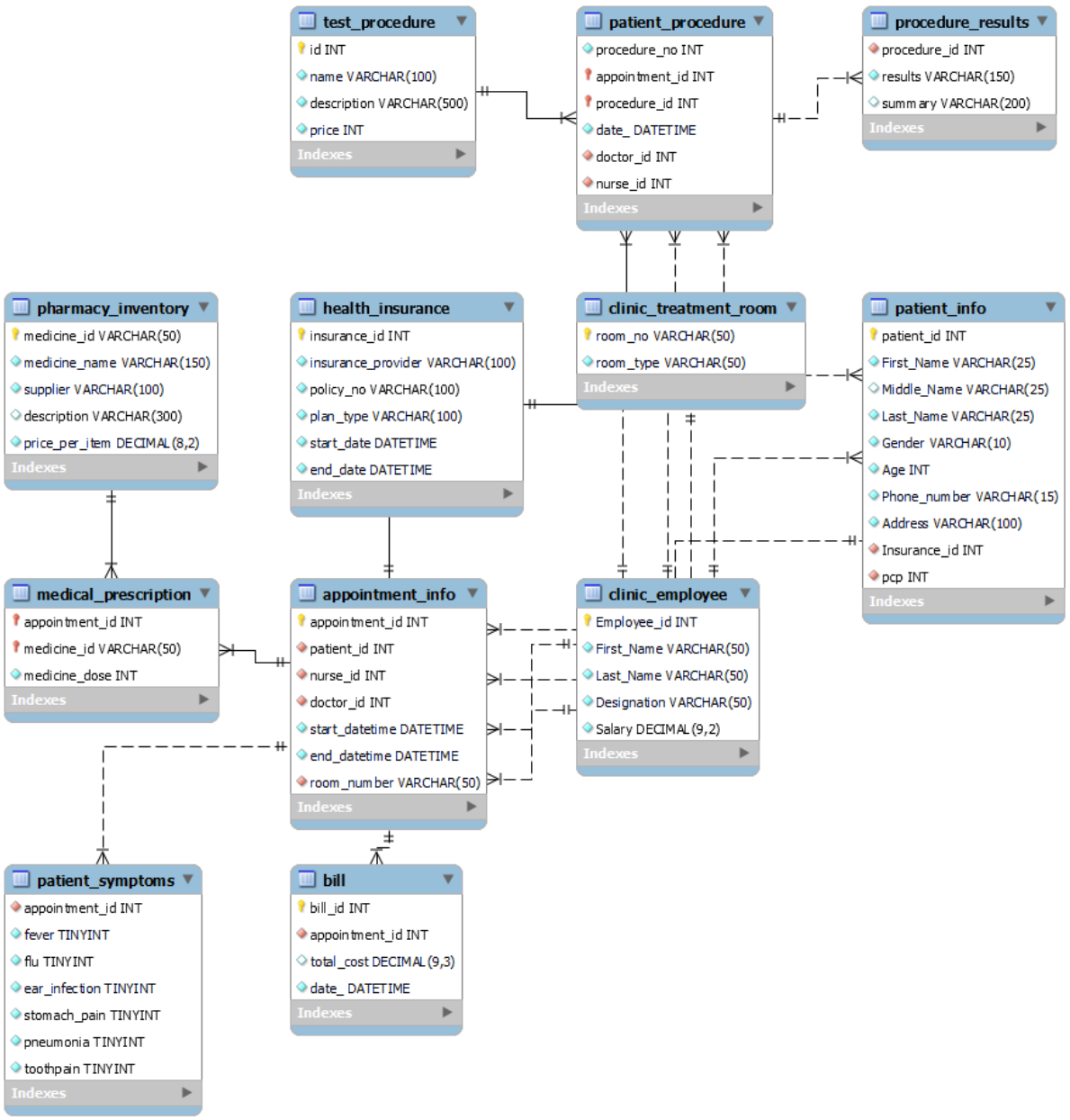

- All tables in database are in BCNF form as all the values in the tables are atomic with unique column names and data in each column belong to same domain. The tables don't have any partial dependencies or transitive dependencies. All the tables satisfy the third normal form.

- For example, if we take a table named medical_prescription it has attributes appointment_id, medicine_id and medicine_dose. Here, appointment_id and medicine_id together act as primary or candidate key. So, appointment_id and medicine_id together will lead to identify the medicine_dose. The medicine_dose itself will not lead to either of medicine_id or appointment_id. That means no prime attribute is dependent on non-prime attribute.

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Basic Information Obtained:

- The total number of employees working for the clinic is 8.
- The count of employees in the clinic whose designation is Nurse is 2.
- The count of doctors in the clinic is 5.
- There is only one receptionist in the clinic.
- A total of 10 patients have been visited the clinic so far.
- A total pf 5 patients have been visited the clinic in the month of march.

Insightful Information Obtained:

- The employee with highest salary in the clinic is Susan James with a salary of 16000.
- The insurance providers for the patients visiting the clinic are Humana, Cigna, Coventry, BlueCross.
- Doctor names Daniel Thomas have treated only one patient till now.
- The only patient who have undergone CT Scan procedure in the clinic so far is Benjamin James.
- Benjamin James have undergone 3 procedures which are CT Scan, Ultra Sound and Cavity Filling.

Tools Used:

- MySQL WorkBench
- Draw.io
- Lucidchart

References:

Murach MySQL TextBook, Course lectures, General children's clinic information on google.