

**Dentist-Patient Data Model**

**Draft 2**

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INFO6210 Database Management Database Design

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# Revision History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Version** | **Changes Made** | **Date** | **Author** | **Comments** |
| 1 | Initial Document | 10/6/2019 | Jayshil Jain | First Draft is Initiated |
| 2 | Second Draft | 10/31/2019 | Jayshil Jain | Improvements to the First Draft |
|  |  |  |  |  |

# 

# Introduction

Under the guidance of **Prof. Vincent Lattuada** I have planned a business model for a Dentist-Patient relationship that will help the dentist in creating, maintaining and evaluating all his patient records. The model will also help the patient in scheduling the appointments and keep track of the appointment details.

The business model is created to solve the inconsistencies in the existing system where the dentist needs to manually keep track of all the appointments all the other patient documents. The patients also need to submit all their documents every time they visit the dentist. The data flow and tracking down all the past patient records will be made simpler and more robust with the new business model.

The general idea is to develop a data model for a dental clinic system. The main entities will include dentist, patient, appointment, room, bill, insurance and treatment. The patient will first need to book an appointment to visit the dentist. While booking, patient needs to register all the demographic details about them. The dentist will confirm the patient appointment. The scheduled appointment will be allocated a room that will have an address and a date and time.

The dentist is responsible to take care of the clinic rooms and must maintain all the equipment’s and check for all the supplies and refill them. The dentist does not include general supplies that are used during the treatment and they are not part of the bill. The dentist sets up all his confidential documents into the Dentist Confidential Documents table like his Bank Account details that will be required to collect payments and make payments to others.

The patient needs to register all the confidential documents before the treatment begins. The patient then attends the appointment and receives the treatment from the dentist and his assistants. After the appointment a bill and prescription are generated by the dentist that will have all the details about the appointment. The tooth identification will store all the details regarding the tooth problem with the tooth id that will help in locating the problem and dentist can help in resolving the appropriate treatment for the same. The Patient can use the prescription at a Pharmacy to get medicines that they need to take post the treatment. The doctor then collects the patient insurance policy and files for the claims and then notifies the patient about the outstanding dues. The patient receives the notification and can clear up all his/her balances with the dentist. The patient then makes the outstanding dues payment.

# Main Subject Areas

**Care Giver**

The care giver cluster will have all the entities that are associated to the dentist who is the care giver in the business model. The caregiver will have all the elements and details regarding the individuals that are directly or indirectly associated with giving treatment to the patient. The entities that are included will be:

* Dentist
* Licenses
* Assistants
* Treatment Catalog
* Dentist Confidential Documents

**Care Receiver**

The care receiver cluster will have all the entities that are associated to the patient who comes to the dentist to receive a treatment. The care receiver will cover all the aspects that are related to the individual that will be receiving the treatment from the caregivers. The entities that are included will be:

* Patient
* Patient History
* Patient Allergies
* Patient Confidential Documents

**Appointment**

The appointment cluster will have all the attributes that are associated to the appointment that takes place between a Dentist and a Patient. The appointment will have all the details about the things that were used or will record data during the period of the appointment. The entities that are included will be:

* Appointment
* Room
* Supplies
* Equipment’s
* Tooth Inspection

**Billing**

The billing cluster will include all the attributes that are associated to the billing section that involves generating an invoice for the patient. The billing cluster will have all the necessary details that help in calculating the final amount a patient will have to pay after the treatment is done. The entities that are included will be:

* Billing
* Outstanding Dues
* Treatment Catalog
* Patient Insurance

**Prescription**

The prescription is the official document given by a dentist through which the patient can get access to medicines from pharmacy. This part will contain all the things the patient has to do after the treatment that will include buying medicines from a pharmacy. The entities that are included will be:

* Prescription
* Pharmacy

# Entities

## Patient

Patient is a person who has specific dental issues and is visiting dental clinic by booking an appointment. Patient will have patient\_name, patient\_address, patient\_contact\_information and a Patient\_id to give him/her a unique identity.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Example | Notes |
| patient\_id | int | pknn | identity 1,1 | 111 | Auto increment by 1 to every new Patient Id |
| fname | char(25) | nn |  | Jeff |  |
| lname | char(25) | nn |  | Smith |  |
| Address 1 | varchar(100) | nn |  |  |  |
| Address 2 | varchar(100) | null |  |  | Address 2 can be empty |
| ZIP | char(5) | nn |  |  |  |
| Contact No. | varchar(10) |  |  |  |  |

## Dentist

Dentist is a person that is officially licensed to operate over the patients and has licensed by the dentistry system. He will have attributes like dentist\_specialization, dentist\_name, dentist\_address, dentist\_contact\_information and a Dentist\_Id to give him a unique identity.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Example | Notes |
| dentist\_id | int | pknn | identity 1,1 | 111 | Auto increment by 1 to every new Dentist Id |
| fname | char(25) | nn |  | Jeff |  |
| lname | char(25) | nn |  | Smith |  |
| Address 1 | varchar(100) | nn |  |  |  |
| Address 2 | varchar(100) | null |  |  | Address 2 can be empty |
| ZIP | char(5) | nn |  |  |  |
| Contact No. | varchar(10) |  |  |  |  |

## Appointment

An appointment is defined as a time frame that patient books prior coming for a visit at dental clinic. Appointments once made can be cancelled and modified based on patient convenience. Appointment will have Appointment\_id, Date, Patient\_id, Dentist\_id.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| appointment\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new Appointment Id |
| patient\_id | int | fknn |  |  |
| dentist\_id | int | fknn |  |  |
| Date Time | datetime | nn |  | Auto Generated upon the entry |
| Address | varchar(100) | null |  |  |
| ZIP | char(5) | nn |  |  |

## License

License is defined as a legal document owned by the dentist or the assistant that is issued by the state using which a dentist can open a clinic and operate over his/her patients. License will have a License\_Number and a License\_Name. A dentist can have more than one licenses.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| dentist\_id | int | pfknn |  |  |
| License Number 1 | varchar(20) | nn |  | Licence Type 1 |
| License Name | varchar(20) | nn |  |  |
| License Number 2 | varchar(20) | null |  | Licence Type 2 |
| License Name 2 | varchar(20) | null |  |  |
| License Number 3 | varchar(20) | null |  | Licence Type 3 |
| License Name 3 | varchar(20) | null |  |  |

## Dentist Confidential Details

Dentist confidentiality contains the confidential documents that are needed to be hided for security reasons. It will contain dentist\_id, Dentist SSN, Dentist Bank Account.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| dentist\_id | int | fknn |  |  |
| Dentist SSN | char(9) | nn |  | SSN needs to be protected and will have limited access |
| Dentist Bank Account | varchar(20) | nn |  |  |

## Room

A room is defined as a place where the treatment action is performed by the doctor on patient. Room will have attributes like room\_id, address, appointment\_id and room\_type where room type will describe facilities available in the room.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| room\_id | Char(1) | pknn | identity 1,1 | Each room is unique and will have a unique char. |
| Address | varchar(100) | nn |  |  |
| ZIP | char(5) | nn |  |  |
| supplies\_id | int | nn |  |  |
| equipment\_id | int | nn |  |  |

## Dentist Assistant

Dentist Assistant is a person who helps and assists dentist during the treatment. Dentist Assistant will have a assistant\_id, fname, lname, Address and contact no.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| Assistant\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new Assistant Id |
| fname | char(25) | nn |  |  |
| lname | char(25) | nn |  |  |
| Address 1 | varchar(100) | nn |  |  |
| Address 2 | varchar(100) | null |  | Address 2 can be empty |
| ZIP | char(5) | nn |  |  |
| Contact No. | varchar(10) |  |  |  |

## 

## Treatment Catalog

A treatment catalog will have all the details about the treatment with a Treatment\_ID assigned to it every treatment will have one treatment\_id and a specific price and name associated to it. The attributes included will be treatment\_id, treatment\_name, price, etc.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| treatment\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new treatment Id |
| treatment name | varchar(20) | nn |  |  |
| treatment price | double(20) | nn |  |  |

## Collective Insurance

The insurance company will contain the list of all insurance company and details about their policies. This will help dentist in filing for insurance claims. The attributes associated would be Insurance\_company\_id, name, invoice\_id, claim\_amount, amount\_covered\_by\_insurance, covered\_by\_patient.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| insurance\_company\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new insurance company Id |
| insurance\_company\_name | varchar(20) | nn |  |  |

## Allergies

The allergies will keep a track of all the allergies that a patient has before starting the treatment so that he/she can make sure he uses medication that suits the patient. Allergies will have attributes like patient\_id, allergy\_id, allergy\_name, items\_to\_avoid, latex\_allergy.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| allergy\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new allergy Id |
| allergy\_name | varchar(20) | nn |  |  |
| latex\_allergy | boolean | nn |  | Either true or false |

## Patient History

A patient history is a table that will store all the details of the patient’s past visits and all the treatments the patient has undergone. Patient history will help doctor to plan out the examinations he/she will be carrying. Patient history will have patient\_id, treatment, date. Patient history will be an associative entity between a patient and appointment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| patient\_id | int | fknn |  |  |
| treatment\_id | int | fknn |  |  |
| appointment\_id | int | fknn |  |  |
| Date | datetime | nn |  | Date time will make each record unique |

## 

## Patient Confidentiality

Patient confidentiality contains the confidential documents that are needed to be hided for security reasons. It will contain patient\_id, Patient SSN, Patient Bank Account.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| patient\_id | int | fknn |  |  |
| Patient SSN | char(9) | nn |  | SSN needs to be protected and will have limited access |
| Patient Bank Account | varchar(20) | null |  |  |
| Patient Credit Card Details | varchar(20) | null |  |  |

## Patient Insurance

Patient Insurance is defined as the insurance a patient is having with him/her that will cover up his dental expenses. A patient can have multiple insurance. The attributes will include patient\_insurance\_id, patient\_id, insurance\_validity, insurance\_policy\_details, insurance\_company\_name.

|  |  |  |  |
| --- | --- | --- | --- |
| Column | Datatype | Key/null | Notes |
| insurance\_company\_id | int | nn | Unique Id for each company |
| insurance\_company\_name | varchar(20) | nn |  |
| patient\_id | int | nn |  |
| policy number | varchar(20) | nn |  |
| Date of Expiry | datetime | nn |  |

## Supplies

Supplies is defined as the major medication supplies (like injections, painkiller, etc.) for which the patient is be billed separately. Supplies will have attributes like supply\_id, appointment\_id, room\_id and date.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| supply\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new supply Id |
| supply\_name | varchar(20) | nn |  |  |
| room\_id | int | nn |  | The room associated will have supply details |
| quantity | int | null |  |  |

## Equipment’s

The equipment’s are defined as the fixed onetime purchase that a dentist has to make in order to setup the clinic. The equipment cost is non-recurring but equipment’s need maintenance. The equipment’s will have a equipment id, equipment name, maintenance\_time(months).

|  |  |  |  |
| --- | --- | --- | --- |
| Column | Datatype | Additional | Notes |
| equipment\_id | int | identity 1,1 | Auto increment by 1 to every new supply Id |
| equipment\_name | varchar(20) |  |  |
| maintainence\_period | int |  | The ideal time after which equipment needs maintenance |

## Billing

The payment is the way patient makes payment to the dentist. There are multiple ways of payment and multiple modes of payment. Multiple ways may include upfront-payment, partial-payments and EMI payments. Modes of payment will include payments by card, cash, etc. Payment will include attributes like appointment\_id, payment\_mode, payment\_way, total\_cost\_of\_treatment, pending\_amount.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| invoice\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new invoice Id |
| cost | money | nn |  |  |
| appointment\_id | int | fknn |  |  |

## Prescription

Prescription is defined as a document issued to the Patient after the treatment is done. This document will contain all the medicines and precautions to be taken by the patient. It will have prescription\_id, precautions, etc.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| prescription\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new Prescription Id |
| appointment\_id | int | fknn |  |  |
| medicine\_id | int | fknn |  |  |
| precaution | varchar(20) | nn |  | This will keep track of the precaution patient needs to take care of |

## Medicine

Medicine is the drugs given to the Patient that will help in recovering from the Treatment. The medicine can only be given by a Pharmacy. The medicines will have a medicine id, medicine name.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| medicine\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new Medicine Id |
| prescription\_id | int | fknn |  |  |
| medicine\_name | int | nn |  |  |

## Pharmacy

Pharmacy is defined as a body that is legally authorized to give patients the medicines and drugs based on the prescription they have. No specific medicines can be given out by a pharmacy without a prescription letter from the Dentist. Pharmacy will pharmacy id, pharmacy name, address.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Column | Datatype | Key/null | Additional | Notes |
| pharmacy\_id | int | pknn | identity 1,1 | Auto increment by 1 to every new Pharmacy Id |
| Pharmacy Name | varchar(100) | nn |  |  |
| Address | varchar(100) | nn |  |  |

## Outstanding Dues

The amount that is pending from the patient end after the insurance has covered its part of the cost. Every invoice will have an outstanding cost if patient wishes to use his/her insurance policy for the payment. The Outstanding dues will be deducted from the patient credit card.

|  |  |  |
| --- | --- | --- |
| Column | Datatype | Key/null |
| invoice\_id | int | fknn |
| Outstanding dues amount | double(10) | null |

## Tooth Inspection

The tooth Inspection will include details about the tooth and the problem associated with the tooth. Each tooth is represented by a tooth\_Id.

The problem will be noted down for 3 levels i.e. crown level, root level and the neck level.

The tooth inspection will also look for general recurring problems like plague, stains, abrasion, cracked tooth, oral cancer and cavity.

|  |  |  |
| --- | --- | --- |
| Column | Datatype | Key/null |
| patient\_id | int | fknn |
| appointment\_id | int | fknn |
| tooth\_id | varchar(max) | nn |
| crown\_level | bit | null |
| neck\_level | bit | null |
| root\_level | bit | null |
| palague | bit | null |
| stains | bit | null |
| cavity | bit | null |
| abtraction | bit | null |
| cracked\_tooth | bit | null |

# Business Rules

## In-scope Business Rules

|  |  |  |
| --- | --- | --- |
| ID | RULE | AREA |
|  |  |  |
| IN01 | Patient details are captured while scheduling and Appointment | Patient |
|  |  |  |
| IN02 | Each Dentist can have only one appointment at a time | Dentist |
|  |  |  |
| IN03 | License of Dentist will be recorded. Dentist can have more than one licenses. | Dentist |
|  |  |  |
| IN04 | One Patient can book more than one appointment. | Patient |
|  |  |  |
| IN05 | License of Assistant will be recorded. Hygienist can have more than one licenses. | Assistant |
|  |  |  |
| IN06 | Dentist’s information is stored | Dentist |
|  |  |  |
| IN07 | There cannot be multiple appointments at a single time for a patient. | Appointment |
|  |  |  |
| IN08 | Dentist prescribe drugs for patients | Prescription |
|  |  |  |
| IN09 | Appointment must contain patient and dentist details. | Appointment |
|  |  |  |
| IN10 | Confidential data such as SSN, Credit Card Number, etc. should be stored in  separate reference table with more security applied to the table. | Confidential  Documents |
|  |  |  |
| IN11 | Patient can have one or more treatments per appointment. | Appointment |
|  |  |  |
| IN12 | Can receive prescriptions from multiple practitioners (Pharmacy). | Prescription |
|  |  |  |
| IN13 | A patient can book multiple appointments but with different timestamp. | Appointment |
|  |  |  |
| IN14 | Dental clinic can have multiple locations and various rooms at every location. | Rooms |
|  |  |  |
| IN15 | Only the drugs prescribed by the Dentist to the Patient will be tracked in this  system as a part of Prescription. | Prescription |
|  |  |  |
| IN16 | Patient can have more than one insurance. | Insurance |
|  |  |  |
| IN17 | Invoice will include the cost of the treatment. Every treatment will have an invoice. | Billing |
|  |  |  |
| IN18 | A Dentist creates his own Treatment Catalog that will have all the  treatment details with a specific price assigned to it. | Treatment  Catalog |
|  |  |  |
| IN19 | Patient must make payment of the amount that was not covered by the  insurance company. | Outstanding  Dues |
|  |  |  |
| IN20 | Dentist claims for all the patients with same insurance company together. | Insurance |
|  |  |  |
| IN21 | The prescription that will be generated will only be used at a pharmacy  to get the medicines. | Pharmacy |

## Out of Scope Business Rules

|  |  |  |
| --- | --- | --- |
| ID | RULE | AREA |
|  |  |  |
| OS01 | Work schedule of other staff apart from the dentist/provider | Dentist |
|  |  |  |
| OS02 | Track of equipment like fax machine, telephone, etc. | Appointment |
|  |  |  |
| OS03 | Finances of the clinic | Dentist |
|  |  |  |
| OS04 | Parking facilities at the clinic | Appointment |
|  |  |  |
| OS05 | Feedback about the Dentist | Dentist |
|  |  |  |
| OS06 | Tracking the supplies items | Supplies |
|  |  |  |
| OS07 | Non-medical personnel who do not contribute in the treatment  of a patient are not tracked here. | Appointment |
|  |  |  |
| OS08 | Salary of staff working with dentist | Billing |
|  |  |  |
| OS09 | Walk-in: Patients go to the clinic without prior appointments. | Patients |
|  |  |  |
| OS10 | Utilities that are being used in the room. | Room |
|  |  |  |
| OS11 | No method for membership plans/discounts to the regular patients  at this dental office | Billing |
|  |  |  |
| OS12 | Things to be avoided during a medication will not be given out from  the dentist side. | Prescription |
|  |  |  |
| OS13 | Waiting time and Stay time in a room for the patient. | Patient |

In-scope Rules:

**Account**

Admin, Dentist, Hygienist, Assistant will be the roles

All the providers of the system will have access to Dental System where they can feed examination records and view/update patient records.

Username and password will be unique for each user and cannot be null.

Each user will be authorized and will be given restricted access rights based on their role.

**Provider**

A provider must have a valid First Name, Last Name, Address, Contact Number.

Provider must have a valid license to carry out his/her work.

A provider can have multiple licenses.

Provide must have a well-defined block time and block time rate.

The block time should be from the range of **5 minutes** to **60 minutes**.

Each license will have an Expiry Date.

Provider can be

Provider must have a valid SSN, Account Number, Routing Number, Bank Name and Tax Identification Number that will be stored in encrypted format.

Each provider must attend all the appointments allocated to him/her.

A provider must create a Treatment Catalog that will hold the treatment type and their Rates.

A provider may or may not give out a prescription to a patient after the appointment.

A provider must update a Treatment Summary once the appointment is done.

**Patient**

The patient entity must have a valid name, age, address, contact information.

The patient may or may not have an Emergency Contact.

The patient may or may not have an insurance.

To book an appointment with the dentist the patient must have a valid dental problem/issue.

For every patient the patient history will be captured which will have details about allergies, medications and basic health metrics.

A patient must register the his/her tooth information (Real and Fake Teeth’s) before the appointment.

The patient can only book one appointment with one provider at a given point of time.

**Appointment**

Appointment must have at least one patient and one provider to be set.

The appointment will have an appointment Status that will have three values U (Upcoming), C (Cancelled) and D (Done) which will change based how the appointment goes.

One appointment can have multiple treatments from Treatment Catalog.

After each appointment, the Treatment summary and Examination Record will be updated.

Room:

Each Appointment will take place in a specific room.

Each room will have a location associated to it.

Supplies will

**Billing**

There will be one invoice generated after each appointment.

The invoice will have the Total Amount that will be derived from the formula:

**Total Amount = Treatment\_Catalog\_Rate + Block\_Rate \* (Appointment\_Time\_Duration / Block\_Time)**

The invoice will hold the amount that will

The payment will hold the re