

USE CASE STUDY REPORT

Group 12

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EXECUTIVE SUMMARY:

The primary objective of this project is to create a database for a local clinic which can be implemented by any small clinic in the United States County. Since, the data storing process has been manual in these clinics all this while it has decreased their productivity. The workforce is also low in these small clinics, so they cannot waste their time going through the data manually. So, we are designing a database which will enable them to store the data regarding appointments, doctor details, patient details, nurse details, administration staff details, drug availability details. If all this information can be obtained easily using a relational database, then they can focus their valuable time on giving quality treatment to the the patients. It also has an analytics platform using which the data can be visualized and useful information can be obtained regarding the patients which need the utmost care.

At first the conceptual modeling was done, EER and UML diagrams were modelled. Following this a relational model was also created mentioning the required primary and foreign keys. This database was then implemented in the MYSQL server. The working of the database in MYSQL has been shown in the study. Then a prototype of three tables with three relations was implemented in the Cypher neo4j playground, also a prototype of two collections was implemented in the Mongo dB playground. These were done to study the feasibility of the database in the NoSQL environment.

The created database was a great success. It was connected to R and Tableau. The analytics capabilities of this database using R is quite good, some of which have been shown in the study. These queries can be very helpful in keeping track of the quantity of drugs bought by each patient from the drug store. A UX interface for the front end of the database was also designed using Balsamiq Wireframes. The final stage of improvement would be to implement data governance measures.

I. INTRODUCTION:

We are trying to implement this database in a small clinic in Middlesex county. We believe after seeing the success of this database, all the small clinics begin to implement such a relational database and improve their productivity which will in turn improve the quality of treatment given to their patients. This database helps the doctors to keep track of the number of appointments each patient has made every month. It can also help them to monitor the number of drugs bought by each patient from a centrally controlled server, thus preventing any kind of wrongdoings wherein a patient buys excess drugs for purposes other than medication. Such kind of behavior can be easily prevented by monitoring from a centrally controlled server.

To support a healthy neighborhood, Middlesex county in MA wants to build a small clinic to help manage patients who live far from public hospitals in Boston. This clinic allows patients to undertake vaccinations, monthly check-ups, or walk in visits. The huge number of patients who come to public hospitals in Boston sometimes causes difficulty to the doctors, and it becomes difficult to the patients who travel from outskirts of Boston for minor check-ups. Therefore, creation of a small clinic in Middlesex county will hugely help its residents. In this project, we are engaged in creating a database to maximize this clinic's performance as we believe that an excellent health database can help the doctors, nurses, and administrative staff hugely by letting them manage all the appointments to the clinic, drugs availability in the pharmacy and the drugs sold to the patients easily. Using the help of proper organization of such a database doctors, nurses and administrative staff working as a team will be able to provide high-quality healthcare to all the patients.



III. Mapping Conceptual Model to Relational Model

DOCTOR (SSN, Name, Joining date, Expertise)

NURSE (SSN, Name, Joining date, Designation)

ADMINISTRATIVE STAFF (SSN, Name, Joining date, Role)

TREATMENT (SSN, PATIENTID)

SSN Foreign key refers to SSN in Doctor, NULL NOT ALLOWED

PATIENTID Foreign key refers to PATIENTID in Patient, NULL NOT ALLOWED

TAKESCAREOF (SSN, PATIENTID)

SSN Foreign key refers to SSN in Nurse, NULL NOT ALLOWED

PATIENTID Foreign key refers to PATIENTID in Patient, NULL NOT ALLOWED

PRESCRIPTION (PRESCRIPTIONID, Drug name, Date, SSN, PATIENTID)

SSN Foreign key refers to SSN in Doctor, NULL NOT ALLOWED

PATIENTID Foreign key refers to PATIENTID in Patient, NULL NOT ALLOWED

PHARMACY (DRUGID, Drug name, Quantity available)

VALIDATE (DRUGID, PRESCRIPTIONID)

DRUGID Foreign key refers to DRUGID in Pharmacy, NULL NOT ALLOWED

PRESCRIPTIONID Foreign key refers to PRESCRIPTIONID in PRESCRIPTION, NULL NOT ALLOWED

WORKSIN (DRUGID, SSN)

DRUGID Foreign key refers to DRUGID in Pharmacy, NULL NOT ALLOWED

SSN Foreign key refers to SSN in Administrative staff, NULL NOT ALLOWED

APPOINTMENT (APPOINTMENTID, Date, Additional information)

ASSIGNEDTO(SSN,APPOINTMENTID)

SSN Foreign key refers to SSN in Doctor, NULL NOT ALLOWED

APPOINTMENTID Foreign key refers to APPOINTMENTID in APPOINTMENT, NULL NOT ALLOWED

ASSIGNEDTO(SSN,APPOINTMENTID)

SSN Foreign key refers to SSN in Nurse, NULL NOT ALLOWED

APPOINTMENTID Foreign key refers to APPOINTMENTID in APPOINTMENT, NULL NOT ALLOWED

IV. Implementing of Relation Model via SQL and NoSQL

A. MySQL Implementation

1. Find all patients that have been treated by dermatologist

```
select p.NAME, P.BOD
FROM patientS p, appointmentS a, doctors d
where p.idpatient = a.id_patient_fk and d.SSN_doc =
a.id_doc_fk and
d.EXPERTISE = "Dermatologist";
```

	NAME	BOD
▶	Glenna G. Miranda	02/04/00
	Elijah W. Lancaster	03/03/16
	Amity Z. Robbins	14/11/96
	Cadman D. Tran	21/04/88
	Keaton G. Stout	25/02/90
	Elvis R. Gill	10/06/77

Result 8 ×

2. Find all drug that have the available_quantity < 5

```
select drug_name, quantity
from pharmacy
where quantity > 5
order by quantity desc;
```

drug_name	quantity
Metformin HCl	10
Albuterol	10
Vytorin	10
Naproxen	10
Potassium Chloride	10
Triamterene/Hydrochlorothiazide	10

3. Find all patient that have been often visit clinic

```
select a.id_patient_fk, p.name, count(*) as times
from patients p, appointments a
where p.idpatient = a.id_patient_fk
group by (a.id_patient_fk)
order by times desc;
```

id_patient_fk	name	times
404	Justin M. Nichols	5
465	Unity K. Stone	5
401	Xenos H. Holman	4
402	Anne T. Ashley	4
442	Shana K. Snider	4
403	Maite E. Powers	3

4. Find all patient that have been treated by which doctors

```
select a.id_patient_fk, p.name as Patient_name, d.name as Doctor_name, n.name as
Nurses_Name, a.date as Appointment
from patients p, appointments a, doctors d, nurses n
where p.idpatient = a.id_patient_fk and d.SSN_doc = a.id_doc_fk and n.SSN = id_nurse_fk;
```

id_patient_fk	Patient_name	Doctor_name	Nurses_Name	Appointment
401	Xenos H. Holman	Lance Mayer	Quon Maddox	01/01/2021
401	Xenos H. Holman	Ursula Underwood	Teagan Berry	12/11/2020
401	Xenos H. Holman	Porter Byrd	Montana Love	29/07/2018
401	Xenos H. Holman	Lois Nieves	Kai Guthrie	12/01/2022
402	Anne T. Ashley	Kristen Sharp	Clementine Jarvis	27/06/2021
402	Anne T. Ashley	Randall Allen	Georgia Mays	24/02/2019
402	Anne T. Ashley	Winter Clay	Chiquita Potts	04/05/2020
402	Anne T. Ashley	Vera Beach	Tashya Sawyer	19/03/2019
403	Maite E. Powers	Thomas Branch	Kylee Wilkinson	19/05/2020
403	Maite E. Powers	Arden Townsend	Maya Mendoza	19/03/2021
403	Maite E. Powers	Lionel Chen	Julie Estrada	02/09/2018
404	Justin M. Nichols	Dileen Soto	Whilemina Bailey	19/06/2020

B. NoSQL Implementation

Two collections (doctors, nurses) have been created in the Mongo dB playground. The following MONGODB queries were done:

Query 1: Query to determine the Expertise of Doctors with the highest average salary, and to display the average salary amount.

```
db.doctors.aggregate(
[
{$group: {_id: "$Expertise", Avgsalary: {$avg: "$Salary"} }},
{$sort: {Avgsalary: -1}},
{$limit: 1}
])
```

Result

```
{ "_id" : "Oncologist", "Avgsalary" : 97019 }
```

Query 2: Query to determine the average salary for each Expertise of the Nurses and display the average salaries in descending order.

```
db.nurses.aggregate(
```

```
[
  {$group: {_id: "$Expertise", Avgsalary: {$avg: "$Salary"}}},
  {$sort: {Avgsalary: -1}},
])
```

Result

```
{ "_id" : "Gynecologist", "Avgsalary" : 67182 }
{ "_id" : "Oncology", "Avgsalary" : 62789 }
{ "_id" : "Womens Health-Gender Related ", "Avgsalary" : 60295.333333333336 }
{ "_id" : "General Surgeon", "Avgsalary" : 60035 }
{ "_id" : "Adult-Gerontology Acute Care", "Avgsalary" : 59796.666666666664 }
{ "_id" : "Emergency", "Avgsalary" : 54033 }
```

Query 3: Query to determine the Nurse with the highest salary.

```
db.nurses.aggregate(
```

```
[
  {$sort: {Salary: -1}},
  {$limit: 1}
])
```

Result

```
{ "_id" : 309, "Name" : "Scarlet Ashley", "Expertise" : "Gynecologist", "Salary" : 67182 }
```

C. CYPHER

Three tables (Doctor, Nurse, Patient) and three relations (TREATS, TREATS, WORKSWITH) were created in the neo4jplayground. The following CYPHER queries were done:

Query 1: Query to display the doctors and nurses who work together and have more than 1 common patients among them.

```
MATCH (doctor:Doctor)--(p:Patient)--(nurse:Nurse),
(doctor)--(nurse)
WITH doctor,nurse,count(*) AS common_patients
WHERE common_patients>1
RETURN doctor.Name,nurse.Name,common_patients
ORDER BY common_patients DESC
```

Result

nurse.Name	common_patients	doctor.Name
Candice Heath	3	Juliet Warner
Iliana Meyers	3	Geoffrey Porter
Stephanie Whitney	3	Randall Allen
Justine Kim	2	Melvin Avila

Query 2: Query to display the names of patients treated by the nurse named Iliana Meyers.

```
MATCH (nurse:Nurse)--(patient:Patient)
WHERE nurse.Name="Iliana Meyers"
RETURN patient.Name
```

Result

patient.Name

Kellie Z. Stuart

Alexander G. Snyder

Oleg Z. Mcfarland

Query 3: Query to display the count of patients treated by each nurse.

```
MATCH (nurse:Nurse)--(patient:Patient)
RETURN nurse.Name, COUNT(patient)
```

Result

nurse.Name	COUNT(patient)
Justine Kim	2
Candice Heath	3
Stephanie Whitney	3
Iliana Meyers	3
Britanni Cervantes	1

Query 4: Query to determine the patient's name and count of doctor for the patient who has the highest number of doctors treating him.

```
MATCH (doctor:Doctor)--
(patient:Patient)
RETURN patient.Name,
COUNT(doctor)
ORDER BY COUNT(doctor) DESC
LIMIT 1
```

Result

COUNT(doctor)	patient.Name
2	Oleg Z. Mcfarland

Query 5: Query to display the doctors and nurses who do not have a patient in common.

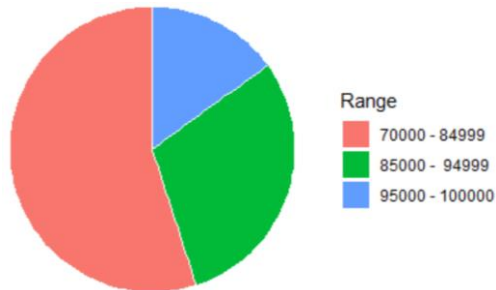
```
MATCH (doctor:Doctor), (nurse:Nurse)
WITH doctor,nurse
OPTIONAL MATCH (doctor)--(patient:Patient)--
(nurse)
WHERE patient IS NULL
RETURN doctor.Name, nurse.Name
```

Result

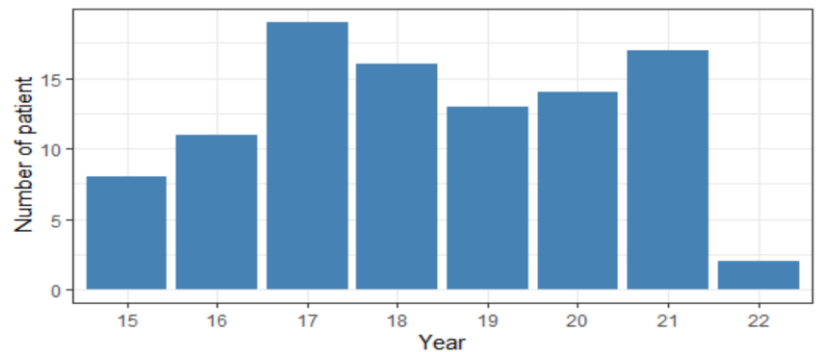
nurse.Name	doctor.Name
Justine Kim	Melvin Avila
Iliana Meyers	Melvin Avila
Stephanie Whitney	Melvin Avila
Candice Heath	Melvin Avila
Britanni Cervantes	Melvin Avila

V. Connecting to Analytics Tools R and Tableau

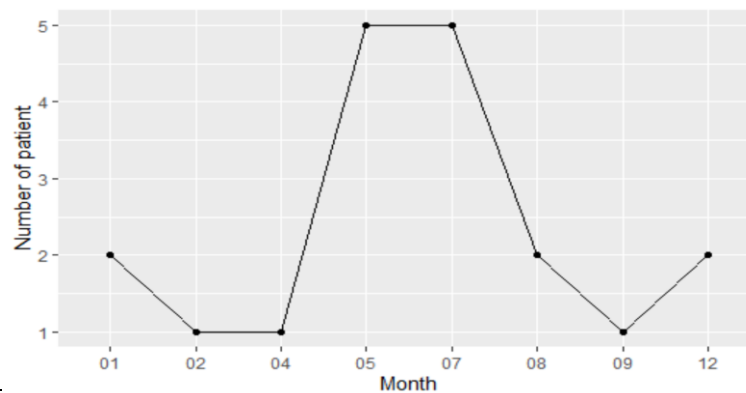
Graph 1: Distribution of salary base on a particular range using R



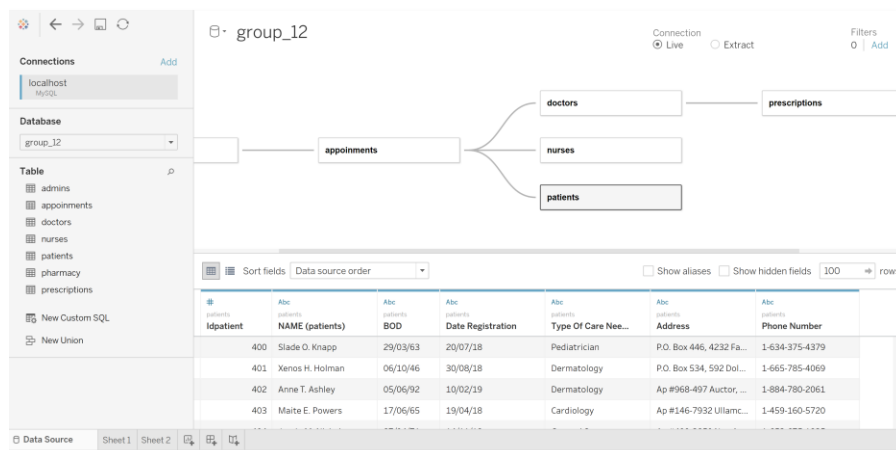
Graph 2: Distribution of patient's number per year using R

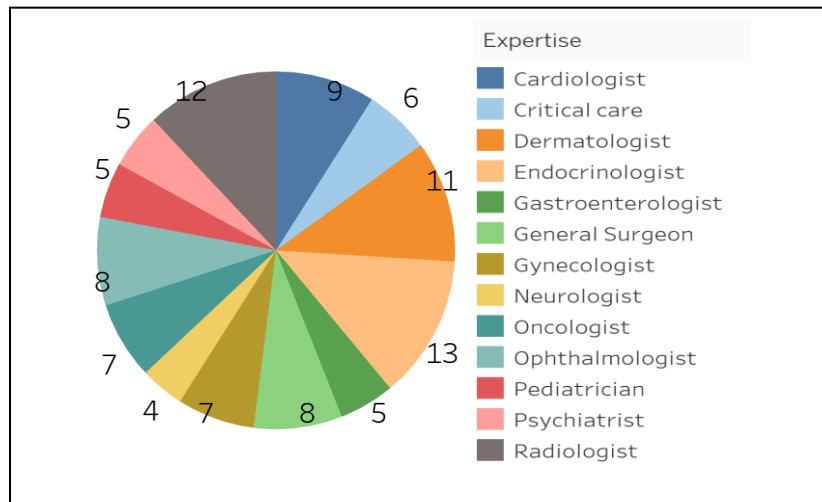


Graph 2: Distribution of patient's number per mont in 2017 using R



The database also connect to Tableau for future's purpose where the second version of database will ask patient's address and provide a delivery prescription





Sample UX Interface using our database for appointment form and prescription form

A Web Page

https://appointmentform.middlesex.clinic

Middlesex Clinic Appointment Form

Patient Name

Birth of Date
 / /

Address

Select an appointment type

☐ Emergency Care

☐ Hospice Care

☐ Long-term Care

☒ Mental Health Care

☐ Speciality Care

☐ Urgent Care

Prescription Sample Form

Dr. Melvin Avila, M.D. Prescription Number: [1234]

[Medical] [Dermatologist] Date: 19/04/2020

+1 (621) 23456

Fluoxetine HCl (PO) 3 times / week

Allopurinol

Patient Name : Slade O. Knapp

Age : 53

Phone number : +1 (621) 78910

Summary and Recommendation:

Middlesex County General database can be implemented by every small clinic in United States County. Using the analytics capabilities of this database the drug availability can be kept in check. The number of appointments to be attended by each doctor can be easily monitored. The number of doctors visited by each patient can be easily monitored. We finally designed the front end UX wireframes for the database as well using Balsamiq Wireframe software.

Improvement on the database would be the implementation of data governance measures on the database to ensure data quality. We were not able to perform extensive study on the NoSQL implementation of the database. We believe that an extensive study of the implementation of the database in NoSQL is required.