Business Narrative

Sunrise General Hospital is a fictional healthcare organization that aims to provide patients with the best cost-effective medicare experience. Providing me with data on their organization, they want to find out insights into their operations in the recent year. Below are the instructions they provided (directly quoting Project 1):

1. Departments coordinate clinical services such as Cardiology, Radiology, Orthopedics, Neurology, Oncology, and Emergency. Each department can have many doctors. Every doctor belongs to exactly one home department.

2. Patients are registered with first name, last name, date of birth, sex, and contact details (phone and email). A patient may optionally have one insurance plan on file; a patient can exist without insurance.

3. Appointments occur at a specific date and time. An appointment involves exactly one patient and exactly one doctor and takes place in one department. A single patient can have many appointments over time, and a doctor can conduct many appointments.

4. Each appointment has a status of Scheduled, Completed, No-Show, or Cancelled. Only completed appointments store a visit duration in minutes.

5. Diagnoses are recorded as standardized codes with descriptions. An appointment can list multiple diagnoses, and a diagnosis can appear on many appointments. Represent this with a separate linking table between appointments and diagnoses.

6. Billing records are created only for completed appointments. Each completed appointment has at most one billing record, and each billing record belongs to exactly one appointment. Billing stores the total charge, the amount paid, the payer, and the bill date.

7. Doctors may be assigned to a home department even if they have not yet conducted any appointments. To be stored, an appointment must reference an existing patient, doctor, and department.

8. Store reasonable identifiers and constraints: When designing tables, make sure each record is uniquely identifiable, and data integrity is enforced.

Entity Relationship Diagram (ERD)

To meet business needs as proposed by the organization, I drafted an ERD below: a schematic showing the cardinality, modality, and relationships between the different entities (doctors, patients, departments, etc), in Sunrise's business structure.

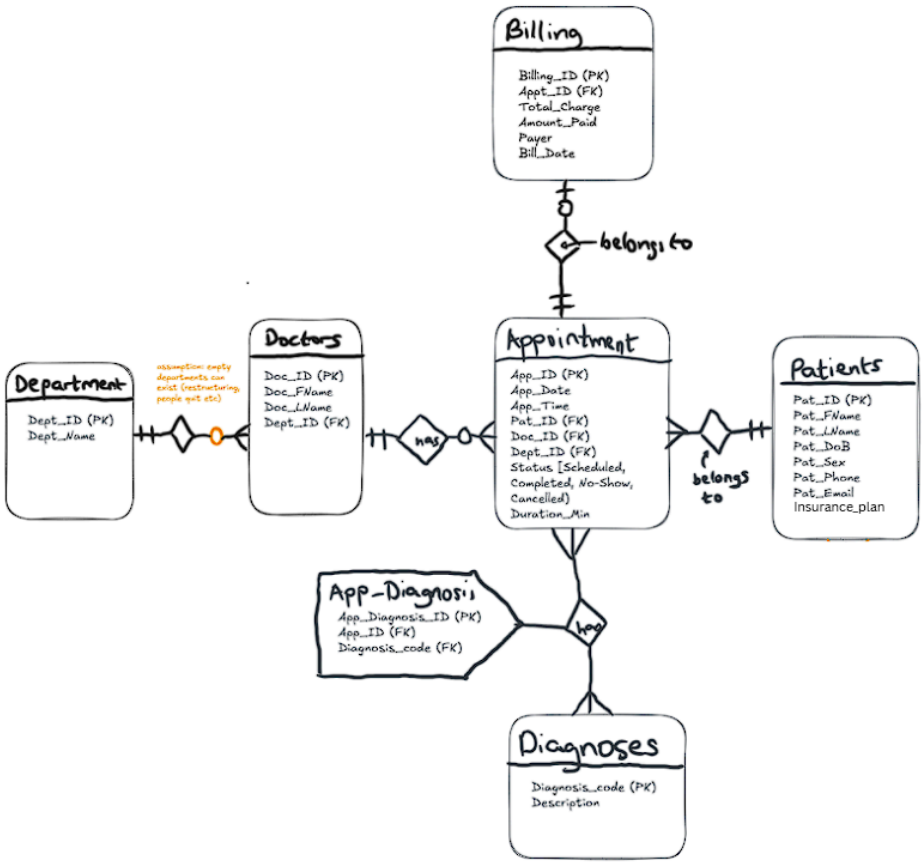

Fig. 1: Entity Relationship Diagram for Sunrise General Hospital

Logical Design

The follow-up to the ERD is normalizing and breaking the ERD down into a logical schema. Here, I explicitly define relationships as they will appear in the database implementation by turning entities into tables, implementing constraints, and noting attributes that will serve as primary and foreign keys: tying together the whole structure computationally. Our final normalized structure was the 3NF, ensuring no functional or transitive dependencies.

3NF Logical Schema (Primary Key - underlined, Foreign Key - italicised)

Department (Dept_ID, Dept_Name)

Doctor (Doc_ID, Doc_FName, Doc_LName, *Dept_ID*)

Appointment (App_ID, App_Date, App_Time, *Pat_ID*, *Doc_ID*, *Dept_ID*, Status, Duration_Min)

Patients (Pat_ID, Pat_FName, Pat_LName, Pat_DoB, Pat_Sex, Pat_Phone, Pat_Email,

Insurance_plan)

Diagnosis (Diagnosis_code, Description)

App_Diagnosis ((Appt_ID, Diagnosis_code), *Appt_ID*, *Diagnosis_code*)

Billing (Billing_ID, *Appt_ID*, Total_Charge, Amount_Paid, Payer, Bill_Date)

Database Implementation

After planning out our data structure, it is time to implement. After much deliberation, my team convinced Sunrise to purchase some cloud storage for our analysis. We booted up a Google Cloud Virtual Machine instance with a Linux OS, installed PostgreSQL remotely, and locally connected to it via database administration programs like DBeaver.

After we supplied our credentials in DBeaver and checked that the connection worked, we created new SQL scripts to create our tables. Here's a sample:

```
create table department (
        Dept_ID serial primary key,
        Dept_Name varchar(100)
);
create table doctor (
        Doc_ID serial primary key,
        Doc_FName varchar(100),
        Doc_LName varchar(100),
        Dept_ID int not null references department(Dept_ID)
);
```

Fig 2: Creating "appointment" and "doctor" tables

On ensuring the SQL query ran successfully, we tested it by adding some mock values into our tables before we went to the next step.

Data Generation & Ingestion

In the next stage of the project, I generated CSV files from a Google Colab Python script that provided sample data for each entity on execution. Now, because of the

schema that we've built, I had to import the sample data in a specific order. This ensured that the dependencies of each table were met before they were filled.

Data Extraction & Analysis

Along the process, I knew I was going to use Tableau Desktop, a data visualization platform, but I had exhausted its two-week trial. This meant I had to settle for the Public Edition - an edition that did not support connections to cloud instances. This meant I could not work directly on the virtual machine that I was building on, but since I had exported the sample data as CSV files, I could recreate the schema idea in Tableau's "Data Source" tab.

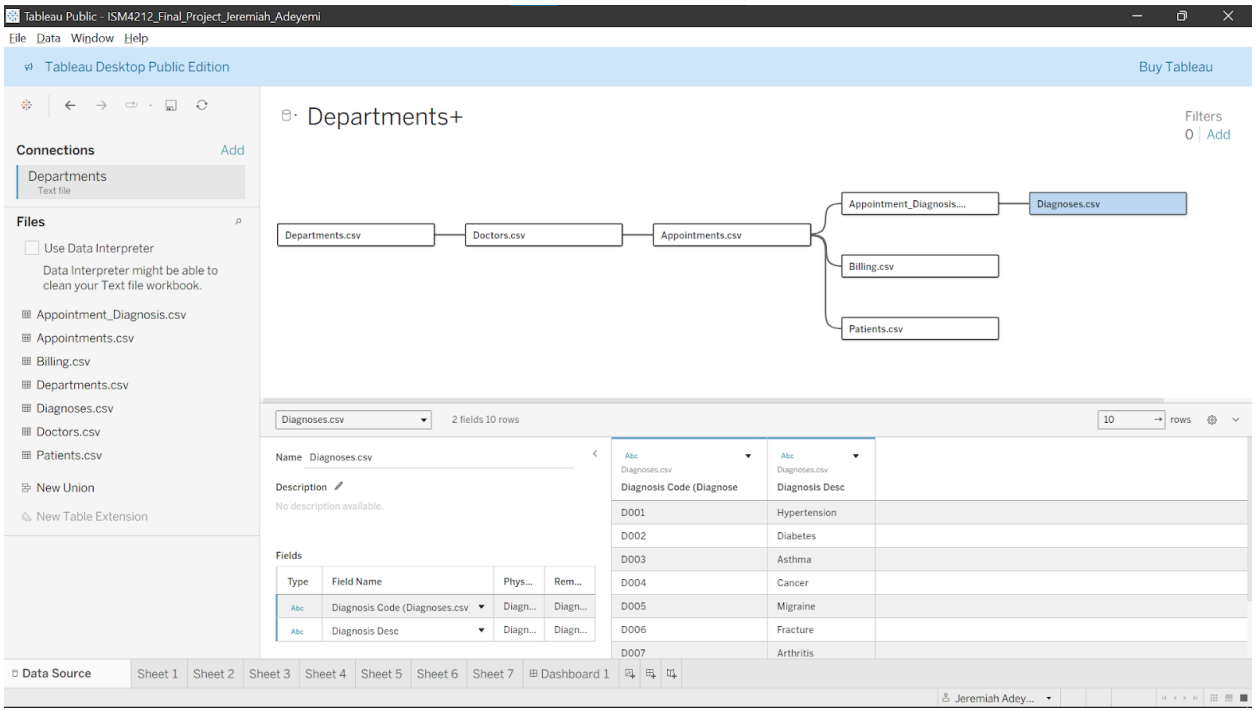

Fig 3: Connecting data samples in Tableau Public

Dashboard - Key Metrics From Sunrise General Hospital

On my Tableau dashboard, I created seven graphs to find metrics and answers to three categories of business questions Sunrise had: patients' demand for appointments, patient demographics, and provider load (to ensure no department has more traffic than it is equipped for). In this section, I will examine each question, along with the related charts and key insights Sunrise General Hospital can use.

To begin our analysis, let's look at patients' demand for appointments.

- Number of Appointments Made Per Month in 2025: This bar chart tracks how many doctor appointments were made each month this year. From the data provided, August had the lowest recorded appointments, with just three scheduled; however, there was a steady increase since then. Meanwhile, February had the peak number of appointments with 13 recorded. For the most part, the non-linear trend indicates randomness and shows little correlation with times in the year.
- Appointment Outcomes (Completed vs No-Show vs Cancelled): In the dataset, not all appointments made were completed, so I wanted to determine whether patients tended to complete their appointments on average. Comparing the ratios on the pie chart, my result was inconclusive: patients were equally likely to complete an appointment as they were to cancel (26% each). A no-show was less likely, but still in range (22%). However, most appointments in February were no-shows.

Moving on, let's consider patient demographics:

- Patient Breakdown by Age Group: Calculating fields in Tableau, I grouped age information of participants into clinically relevant brackets (0-17, 18-34, 35-49, 50-64, 65+). Based on the grouping and in decreasing order, most people fell in the age group 18-34 (adults), followed by age group 35-49 (middle adulthood), 50-64, 65+, and then age group 0-17. More analysis will be done with equal-width bins for us to be sure that we aren't skewing the data by grouping.
- Insurance Distribution (Plan A vs Plan B vs No Insurance): In general, most patients were under Plan B insurance care (40%), followed by Plan A (32%). The rest didn't offer an insurance plan to the hospital.
- Sex Ratio: Most patients were women.

Finally, we can look at the provider load:

- Department Workload (Patient Seen Per Department): From our data, it's clear that the Radiology department treated the largest number of patients this year. Sunrise General Hospital can better support this department by increasing the number of wards, hiring more specialists, and investing in efficient equipment.
- Provider Workload (Patients Seen per Doctor): Doctor 18 of the Radiology department worked with the most patients, treating nine of them. This further substantiates the need to support the Radiology department.

Key Lessons Learned

From the analysis above, we found that the average patient who visited Sunrise General Hospital in 2025 is most likely an adult woman seeking treatment via its Radiology department.

When she schedules a doctor's appointment, she is no more likely to visit than she is to cancel or miss her appointment - an observation that needs to be significantly improved, so that the hospital does not set aside doctors for nothing.

She's also more likely to be on Plan A's insurance plan.

Findings & Recommendations

Based on my analysis, I proposed the following changes:

- Follow-ups on patient appointments scheduled: When a patient schedules a doctor's appointment, the hospital can request to use their phone number or email messaging to remind them of their appointment some days before. Another step further is giving patients the option to reconfirm their appointment. Perhaps this is an administrative function and role that can be employed for or automated via budget-friendly SaaS (software-as-a-service) technologies.
- Collaborations between Sunrise and Insurance companies: Since most patients seem to favour either Plan A or Plan B, with no other option in between, there is room for a partnership with both insurance plans. Perhaps this can be done via negotiation of special rates for customers at Sunrise, and table discussions to improve patient-centered care.
- Improved assignment strategy for Doctors and Patients: While most patients can set up appointments with a doctor, a good number of patients aren't matched up with one. We should investigate why these patients are in medical limbo, and if we can work out a plan to ensure that they're still cared for, e.g, regular check-ups from non-specialists or doctors unassigned to cases.

These were some insights I found from analyzing Sunrise's healthcare data, and that concludes my report on the organization.