UNSW Business School
School of Information Systems and Technology Management

GROUP ASSIGNMENT COVER SHEET

Group (No/Name): T18A-1

Group Leader Name: Xinyu LI

Course: INFS1603-COMM1822

Tutorial time: Tuesday 6-8pm

Tutor Name: Shilpa Sanjeev

Assignment Title: INFS1603-COMM1822 Group Assignment

Due Date: Week 10

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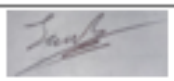
Z5255250	Xinyu Li		12/11/2020
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SGH HOSPITAL MANAGEMENT SYSTEM

I-T18A-1 ASSESSMENT: TRIMESTER 3 2020

WORD COUNT:

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1. Executive Summary

Continuum Consultants have been commissioned by SGH Private Hospital (SGHPH) to design and implement the database management system (DBMS), known as SGH Hospital Management System (SGHHMS). As SGHPH is a large, multi-specialty facility, the SGHHMS is constructed with the primary focus on operational efficiency and the streamlining of user accessibility. Ultimately, such system aims to sustain the multiplexity of all company information of various departments and ensure SGHPH's reputation as a quality medical service provider is upheld.

This report underlines the identification of key stakeholders involved in this organisation's logistic processes and primary objectives considered by all parties. Additionally, Continuum Consulting outlines the project scope and assumptions of the SGHHMS. For referral regarding key entities, relationships and attributes of this database system, an Entity Relationship Model (ERD) and Relational Model (RM) have been provided.

Furthermore, descriptions regarding the features and ethical considerations of the SGHHMS are enclosed, as well as contingency plans for system improvements. Additionally, Continuum Consultants has included a critical reflection regarding team performance during the development of the SGHHMS.

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2. Requirement Analysis

2.1: OBJECTIVES

Based on industry trends, Continuum Consultants identify the industry-wide effort to design and construct reliable and user-friendly database systems that mitigate issues of an ‘explosion of information’ prevalent in the medical industry (Donovan, 2019). As large, multi-specialty enterprises like SGHPH are faced with the complexities of processing the data of a substantial quantity of stakeholders and departments, a transition from traditional file systems (TFS) to that of a DBMS is necessitated (C., C., and E., 2018). Thus, by implementing the SGHHMS, we aim to obtain the primary benefit of improved **operational efficiency (1),** which is quintessential in sustaining SGHPH’s standards of quality medical service within its industry. Furthermore, with the prioritization of stakeholder interests, the SGHHMS will target streamlined **user accessibility (2),** which consequently ensures that data integrity is sustained internally.

OPERATIONAL EFFICIENCY

SGHPH is required to retain the medical history of all their patients within their medical records (Rathinaswamy & Pichandy, 2017). The primary focus of the SGHHMS is to ensure that SGHPH’s operational efficiency in data processing is sustained. To guarantee efficient management of patient medical histories, the database is designed to be continuously updated to generate accurate timestamps on patient data. Furthermore, the SGHHMS is an electrically linked and centralised database, which will mitigate the likelihood of data duplication. This consequently ensures that our objective of obtaining the primary benefit of improved operational efficiency is achieved, while maintaining the reputation of SGHPH as a quality medical service provider for their external stakeholders.

USER ACCESSIBILITY

To ensure that the primary benefits of the DBMS will be observed immediately, the SGHHMS is designed with user accessibility being a top priority. Our decision to utilise Oracle12g (with SQL) as an industry standard database platform ensures user simplicity. This is integral in our objective of developing a DBMS that has a consensus for easy use and capabilities for collective utilisation by all primary stakeholders, regardless of background expertise in database management systems.

Consequently, such design of the SGHHMS aims to streamline the administrative processes present in our private enterprise, as it ensures that the achievement of data integrity is effortless for all persons involved. Additionally, such design will allow for more time-efficient logistic procedures to be observed, thus contributing to the achievement of our primary goal for operational efficiency.

2.2: STAKEHOLDERS

To ensure the success of the SGHHMS, the interests of our stakeholders are prioritised. As hospitals are key institutions, where efficient service delivery is paramount to a happy society (C., C. and E., 2018), it is essential that adequate planning is considered. Continuum Consultants have distinguished primary (internal) and secondary (external) stakeholders that are directly and indirectly affected by the implementation of our DBMS.

PRIMARY STAKEHOLDERS

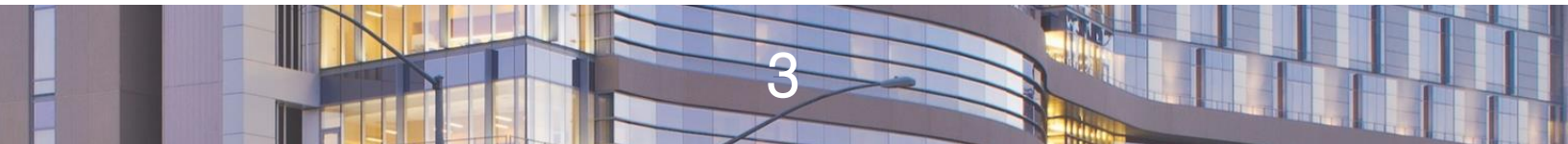
General Staff

By implementing the SGHHMS, general staff, specifically, *general doctors and nurses* are expected to benefit. According to research, the utilisation of a centralised electronic database will improve the efficiency of personnel due to simple user accessibility and increase the overall quality of medical treatment (Quantin et al, 2011). Based on industry trends, *87% of physicians think it is 'extremely important to access medical records when required,* to provide better service delivery and make more effective decisions on patient prescriptions and diagnosis (Matthews, 2019). Thus, as the SGHHMS readily provides constantly updated patient records within the database, the general staff at SGHPH will consequently be able to benefit from a higher level of operational efficiency.

The increased operational efficiency can also benefit *administrative staff.* The SGHHMS will entail more accessibility of hospital statistics like, patient capacity, number of employees and health insurance information (Rathinaswamy & Pichandy, 2017). This will reduce the likelihood of overlaps and errors from occurring logistically, as the DMBS will introduce a stronger level of communication between departments. Furthermore, in light of COVID-19, the SGHHMS aims to archive all results of the screening process to ensure that the administrative staff will be able to substantially align with government regulations and COVID track if needed.

Specialists

The SGHHMS will allow for specialists to formulate more effective and efficient decisions for every patient. The referral to medical records will aid in finding the best diagnosis to treat patients (C., C. and E., 2018). As specialists are responsible for the treatment of their assigned patients, and have a duty of care, the constant updates of patient condition and clinical results will support the achievement of such responsibility. Furthermore, specialists can refer to past treatment and surgeries performed to past patients as precedent to ensure that future decisions are grounded with substantial evidence of success.



Social Workers

Personnel in this field of work are required to collaborate with general staff (general doctors, nurses etc), while being the intermediary between medical operations and the patient (Renata, 2019). By implementing the SGHHMS, social workers can quickly access updated information regarding the patient's condition and provide accurate information about future treatment and checkups. Thus, the increased operational efficiency of the SGHHMS is expected to make a positive impact for social workers.

Technicians

Technicians input datasets extracted from laboratory tests in the SGHHMS. Thus, personnel in this category will indefinitely affected by a transition to a DBMS. The close relation between specialists and technicians validate the necessity to utilise a centralised database as results of patient laboratory tests are often required immediately for specialists to conduct further proceedings with patients. Although technicians may have to learn how to operate Oracle12g, the capabilities of the SGHHMS to provide prompt updates on patient results necessitates the indefinite impact of implementation.

SECONDARY STAKEHOLDERS

Visitors

Although the SGHHMS will only be accessed by primary stakeholders, the streamlined internal processes will be of a marginal benefit for visitors. As it will be easier for administrative staff to access information regarding patients and their respective bed and room details, a higher level of service quality will be provided to visitors due to increased operational efficiency. Additionally, as hospital visits are often urgent and spontaneous, with high levels of stress, the SGHHMS can be used to alleviate visitor concerns. General staff can quickly access accurate information relating to patient condition, which can thereby be used to informed visitors. This consequently observes an overall increase in service quality and operational efficiency that can be appreciated by SGHPH guests.

Patients

The central purpose of SGHPH is to ensure that patients are given a high quality of service. As the SGHHMS aims to improve the accessibility of records for medical staff through a centralised database, patients will be able to experience a more time-efficient service. Furthermore, as the system is constantly updated, patients will be more treated more accurately, which will therefore sustain the quality of healthcare. Thus, it is evident that the improved efficiency resulted from DBMS implementation will be beneficial for patients.

2.3. Scope

The scope of the SGHHMS is internally focused, reflecting interactions between internal stakeholders and hospital facilities. All entities listed in the DBMS are related to operational procedures, with their attributes and relationships used for local assessments or evaluations within SGHPH, like outpatient conditions or inpatient hospital events (Martin, 2008). A list of entities in the scope of the SGHHMS are listed below:

In-scope: Key Facilities

- Building
- Department
- Laboratory
- Room
- Bed

In-scope: Key stakeholders

- General Staff; General Doctors, Nurses, Administrative Staff, Technicians
- Specialists
- Social Workers
- Patients
- Visitors (Attributes relating to COVID-19 tracking only)

In-scope: Key Tasks

- Treatment
- Check-up
- Results (COVID-19 tracking)

Entities not mentioned are considered out of the scope of the SGHHMS.

Furthermore, the SGHHMS has implemented Data Control Language (Oracle12g) to limit user permissions. Internal stakeholders will only be able to access data relevant to their own procedures (Technicians will not be granted specific information about patients etc). This will lower the scope of user accessibility on attributes unrelated to their day-to-day procedures.

3. ER DIAGRAM

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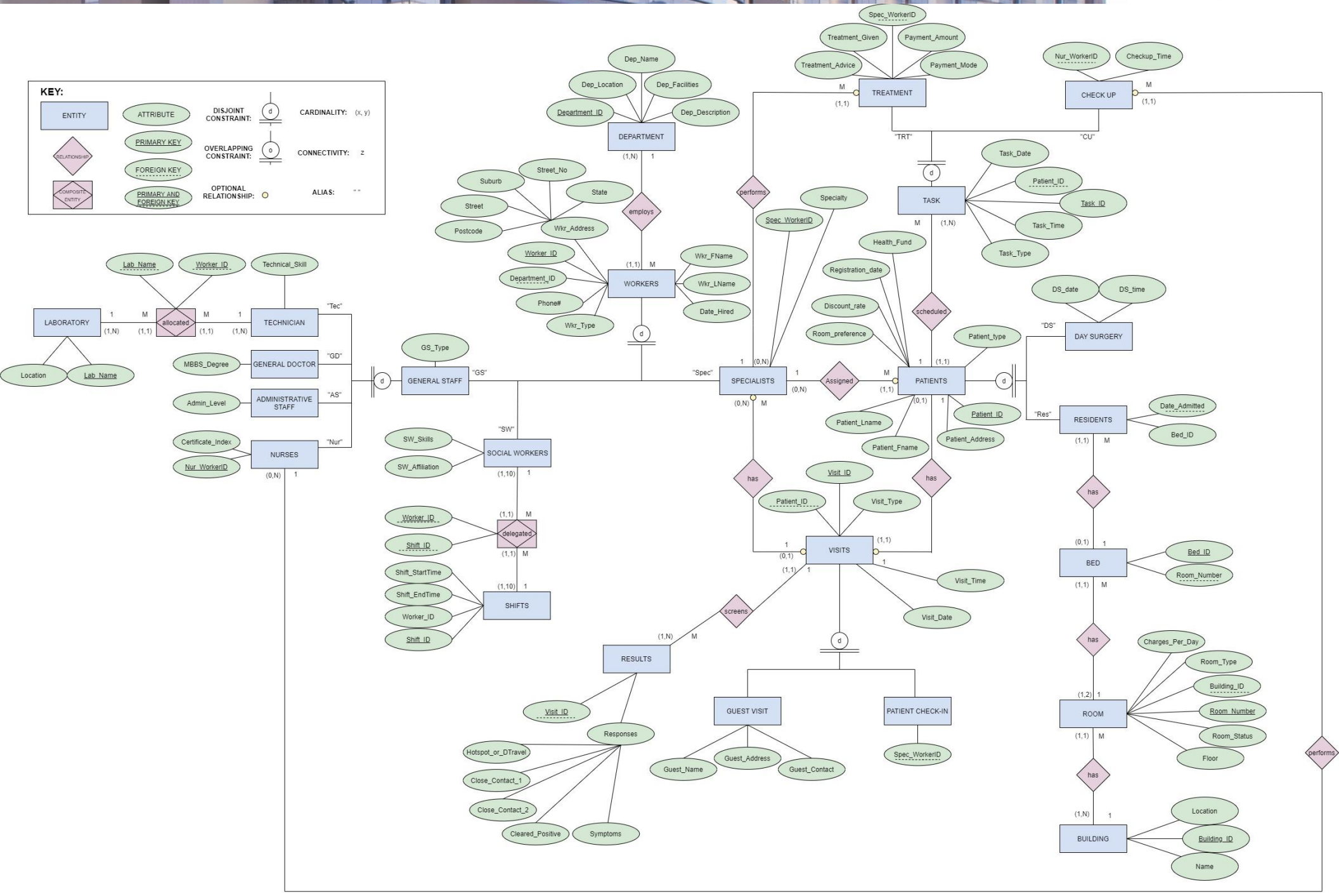

3.1. Assumptions

Laboratories are not rooms.	Laboratories are used by technicians and have one or more technicians assigned whereas rooms are used by residents.
Visitors who visit patients are called guests.	Visitors who accompany or visit patients (e.g. family member or guardian) but are not receiving any treatment or checkup service, are known as guests.
There are two types of Visits at SGH.	Patients can either have a guest visit (where they are visited) or they can have a check-in (where they visit a specialist).
All visitors are screened.	All patients, guests and staff are screened for COVID-19 precautionary measures prior to entering the hospital. Records are saved for 30 days.
Specialists may not always be assigned to a patient.	Specialists do not have regular weekly shifts as they are only required to work when they have a scheduled treatment or an appointment with an assigned patient.
Specialists oversee aiding the treatment process and may not necessarily be the one performing the treatment.	Assigned specialists will help carry out the treatment process for their patient e.g. consultation. However, if the specialist identifies that the treatment requires a different specialty/specialty, they may schedule another specialist/s to perform the treatment.
Every patient receives a check-up and will receive treatment if the nurse feels necessary.	Patients visit SGH for either a scheduled treatment or checkup. However, if the nurse deems necessary after a checkup, a specialist will be assigned to the patient to perform treatment
Workers can only be one worker type.	Workers can only be one worker type (e.g. social worker or specialist), however, workers can assist in different areas.
General Staff workers cannot be more than one type.	General staff workers all specialise in a specific type, for example, technician or nurse.
Not all beds may be used at all times.	Patients have an option of becoming a resident or leaving after day surgery. Thus, the bed and resident's entity possess an optional relationship and this relationship may not always be fulfilled.
Every building and bed within SGH possess a unique identifier.	Each hospital building and bed within SGH has a unique identifier, whereas rooms do not.
All hospital buildings have different names.	All buildings in SGH have different names and identifiers.
Everyone who visits a specialist is identified as a "patient".	Regardless of whether a treatment is required, anyone who visits or books an appointment with a specialist is identified as a "patient" at SGH.

4. RELATIONAL MODEL

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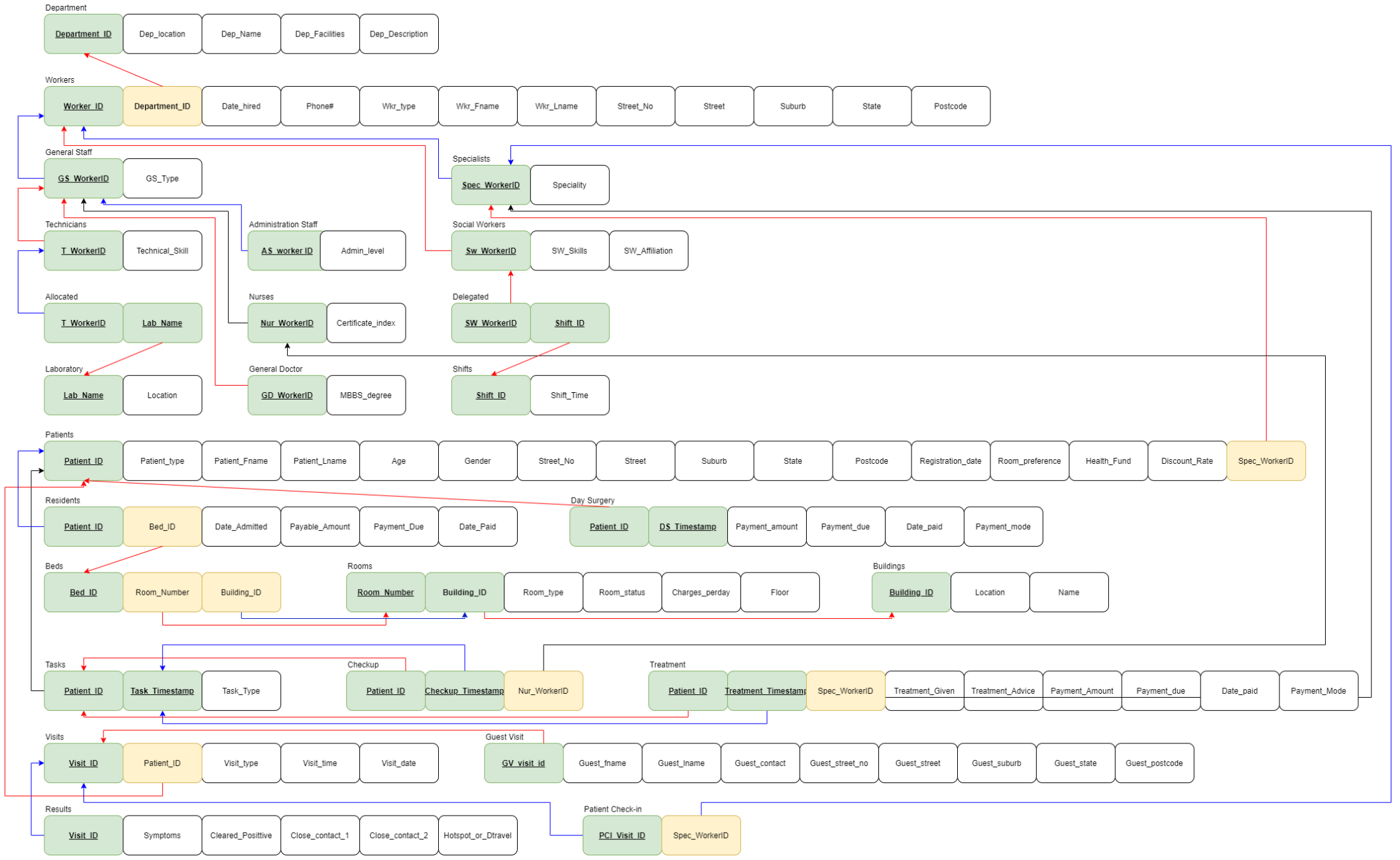
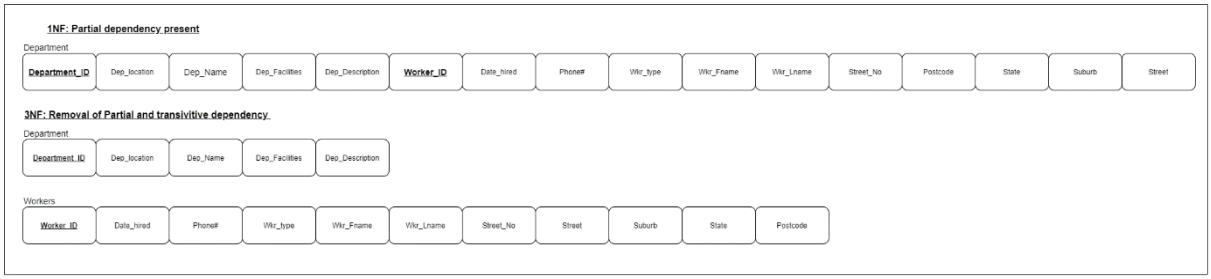


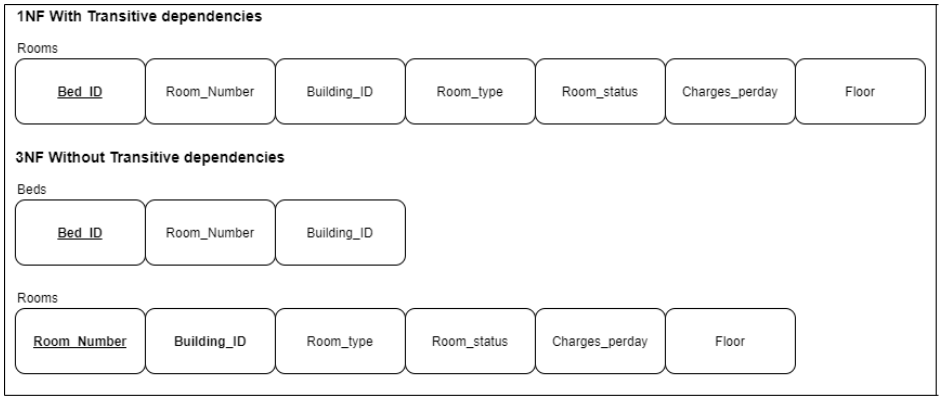
4.1: Relational model and Normalisation

Normalization process was a systematic approach utilised by our team to ensure the elimination of data redundancy through the decomposition of large tables. Updating the relation model to Third Normal Form (3NF) not only enhances clarity but also prevents data anomalies.

To achieve these partial dependencies were initially eliminated for the model to be in Second Normal Form (2NF) as well as ensuring the existence of a primary key for each entity. The department entity contained information of department information as well as employees assigned and working under their regarded departments. Department_ID was the primary key used to uniquely identify the different departments whilst Worker_ID identified each worker assigned to the departments. However, attributes such as Date_Hired could be determined through Worker_ID thus a separate entity of Workers was created to remove these partial dependencies



Similarly, Transitive dependencies was also removed from entities such as rooms to update the model to 3NF. As Bed_ID → Room_Number and Room_Number→ Room_type therefore meaning the existence of transitive dependence within Bed_ID → Room_type. This was removed through the addition of a Beds entity where it is identified through the PK of Bed_ID. The model now has been updated to 3NF with no existing partial nor transitive dependencies.



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5. DATA DICTIONARY

	Attribute Name	Contents	Data Type	Format	Range	Nullable	PK/FK	FK Reference Table
Department	Department_ID	Unique 3 digit department identification number	NUMBER(3,0)	999	100-999		PK	
	Dep_Location	Department location in hospital based on coordinates on a map	VARCHAR2(3)	Xxx				
	Dep_Name	Name of the department	VARCHAR2(50)	Xxxxxx				
	Dep_Facilities	Facilities available in the department	VARCHAR2(50)	Xxxxxx				
	Dep_Description	Department Description	VARCHAR2(150)	Xxxxxx		Y		
Workers	Worker_ID	Unique 4 digit worker identification number	NUMBER(4,0)	9999	1000-9999		PK	
	Department_ID	Unique 3 digit department identification number	NUMBER(3,0)	999	100-999		FK	Department
	Date_Hired	Date when the worker was hired	DATE	DD/MM/YY				
	Phone#	Phone number of the worker (Mobile or Landline)	CHAR(10)	9999999999				
	Wkr_Type	Worker is either a general staff (GS), specialist (S) or social worker (SW)	VARCHAR2(20)	Xxxxxx	GS, S or SW			
	Wkr_FName	First name of the worker	VARCHAR2(20)	Xxxxxx				
	Wkr_LName	Last name of the worker	VARCHAR2(20)	Xxxxxx				
	Street_No	Street number (Address)	NUMBER(3,0)	999	0-999			
	Street	Street name (Address)	VARCHAR2(100)	Xxxxxx				
	Suburb	Suburb (Address)	VARCHAR2(100)	Xxxxxx				
	State	State acronym (Address)	VARCHAR2(3)	Xxx				
	Postcode	Postcode of the worker's residential address	NUMBER(4,0)	9999	1000-9999			
General Staff	GS_WorkerID	Unique 4 digit worker identification number - from general staff	NUMBER(4,0)	9999	1000-9999		PK/FK	Workers
	GS_Type	Worker is either a nurse (N), technician (T), general doctor (GD) or administrative staff (AS)	VARCHAR2(2)	Xx	N, T, GD or AS			
Social Workers	SW_WorkerID	Unique 4 digit worker identification number - from social workers	NUMBER(4,0)	9999	1000-9999		PK/FK	Workers
	SW_Skills	Skills of the social worker	VARCHAR2(100)	Xxxxxx				
	SW_Affiliation	University/Institution of the social worker	VARCHAR2(100)	Xxxxxx				
Specialists	Spec_WorkerID	Unique 4 digit specialist identification number - from specialists	NUM(4,0)	9999	1000-9999		PK/FK	Workers
	Speciality	Speciality of the specialist	VARCHAR2(50)	Xxxxxx				
Technicians	Tech_WorkerID	Unique 4 digit worker identification number - from technicians (in general staff)	NUMBER(4,0)	9999	1000-9999		PK/FK	General Staff
	Technical_Skill	Technical skill of the technician	VARCHAR2(100)	Xxxxxx				
General Doctor	GD_WorkerID	Unique 4 digit worker identification number - from general doctors (in general staff)	NUMBER(4,0)	9999	1000-9999		PK/FK	General Staff
	MBBS_Degree	University/Institution and Year that the MBBS Degree was obtained	VARCHAR2(100)	Xxxxxx				
Administrative Staff	AS_WorkerID	Unique 4 digit worker identification number - from administrative staff (in general staff)	NUMBER(4,0)	9999	1000-9999		PK/FK	General Staff
	Admin_Level	Administrative staff level (Manager, Assistant, etc.)	VARCHAR2(20)	Xxxxxx				
Nurses	Nur_WorkerID	Unique 4 digit worker identification number - from nurses (in general staff)	NUMBER(4,0)	9999	1000-9999		PK/FK	General Staff
	Certificate_Index	Qualification of nurse (Assistant, Senior, etc.)	VARCHAR2(50)	Xxxxxx				
Allocated	T_WorkerID	Unique 4 digit worker identification number - from technicians (in general staff)	NUMBER(4,0)	9999	1000-9999		PK/FK	Technicians
	Lab_Name	Name of the laboratory	VARCHAR2(50)	Xxxxxx			PK/FK	Laboratory
Laboratory	Lab_Name	Name of the laboratory	VARCHAR2(100)	Xxxxxx			PK	
	Location	Location of the laboratory in hospital based on coordinates on a map	100-999	Xxx				
Delegated	SW_WorkerID	Unique 4 digit worker identification number - from social workers	NUMBER(4,0)	9999	1000-9999		PK/FK	Social Workers
	Shift_ID	Unique shift identification code	CHAR(5)	XXXXX	XXX-0 - XXX-9		PK/FK	Shifts
Shifts	Shift_ID	Unique shift identification code	CHAR(5)	XXXXX	XXX-0 - XXX-9		PK	
	Shift_Time	Day of the week and times of the shift	VARCHAR(20)	Xxxxxx				
Patients	Patient_ID	Unique 5 digit patient identification number	NUMBER(5,0)	99999	10000-99999		PK	
	Patient_Type	Type of patient (Resident, Day Surgery)	VARCHAR2(20)	Xxxxxx				
	Patient_FName	First name of the patient	VARCHAR2(20)	Xxxxxx				
	Patient_LName	Last name of the patient	VARCHAR2(20)	Xxxxxx				
	Age	Age of the patient	NUMBER(3,0)	999	0-999			
	Gender	Gender of the patient (Male (M), Female (F))	CHAR(1)	X	M or F			
	Street_No	Street number (Address)	NUMBER(3,0)	999	0-999			
	Street	Street name (Address)	VARCHAR2(100)	Xxxxxx				
	Suburb	Suburb (Address)	VARCHAR2(100)	Xxxxxx				
	State	State acronym (Address)	VARCHAR2(3)	XYZ				
	Postcode	Postcode of the patient's residential address	NUMBER(4,0)	9999	1000-9999			
	Registration_Date	Date of first contact with the hospital	DATE	YYYY-MM-DD				
	Room_Preference	Type of room preference of the patient	VARCHAR2(40)	Xxxxxx				
	Health_Fund	Health fund of the patient (if any)	VARCHAR2(20)	Xxxxxx		Y		
	Discount_Rate	Discount rate that the patient receives (if any; as a percentage)	NUMBER(4,2)	99.99	0-99.99	Y		
	Spec_WorkerID	Unique 4 digit worker identification number	NUMBER(4,0)	9999	1000-9999		FK	Specialists
Buildings	Building_ID	Unique 2 digit building identification number	NUM(2,0)	99	0-99		PK	
	Location	Building location in the hospital based on coordinates on a map	VARCHAR2(3)	Xxx				
	Name	Name of the building in hospital	VARCHAR2(50)	Xxxxxx				
Rooms	Room_Number	3 digit room identification number	NUMBER(3,0)	999	0-999		PK	
	Building_ID	Unique 2 digit building identification number	NUMBER(2,0)	99	0-99		PK/FK	Buildings
	Floor	Floor number of the building that the room is located in	NUMBER(1,0)	9	0-9			
	Room_Type	Type of room (Room w/ 1 Bed, Room w/ 2 Beds, Room w/ 1 Bed, or Living Room)	VARCHAR2(40)	Xxxxxx				
	Room_Status	Availability of room (Occupied, Vacant)	VARCHAR2(10)	Xxxxxx	Occupied or Vacant			
	Charges_Per_Day	Cost of bed admission per day	NUMBER(5,2)	999.99	0-999.99			
Bed	Bed_ID	Unique 3 digit bed identification number	NUMBER(3,0)	999	100-999		PK	
	Room_Number	3 digit room identification number	NUMBER(3,0)	999	0-999		FK	Rooms
	Building_ID	Unique 2 digit building identification number	NUMBER(2,0)	99	0-99		FK	Rooms
Residents	Patient_ID	Unique 5 digit patient identification number	NUMBER(5,0)	99999	10000-99999		PK/FK	Patients
	Bed_ID	Unique 3 digit bed identification number	NUMBER(3,0)	999	100-999		FK	Bed
	Date_Admitted	Date of admission	DATE	YYYY-MM-DD				
	Payable_Amount	Total Amount payable	NUMBER(6,2)	9999.99				
	Payment_Due	Amount of payment due	NUMBER(6,2)	9999.99				
	Date_Paid	Date payment is paid	DATE	DD/MM/YY		Y		

Day Surgery	Patient_ID	Unique 5 digit patient identification number	NUMBER(5,0)	99999	10000-99999		PK/FK	Patients
	DS_Timestamp	Date and time of the day surgery	TIMESTAMP	DD/MM/YY HH:MM:SS			PK	
	Payment_Amount	Total day surgery payment amount	NUMBER(7,2)	99999.99	0-99999.99			
	Payment_Due	Amount of payment due	NUMBER(7,2)	99999.99	0-99999.99			
	Date_paid	Date payment is paid	DATE	DD/MM/YY		Y		
	Payment_Mode	Payment mode used (e.g. cash, debit, credit)	VARCHAR2(10)	Xxxxxx				
Tasks	Patient_ID	Unique 5 digit patient identification number	NUMBER(5,0)	999	100-999		PK/FK	Patients
	Task_Timestamp	Date and time of the task	TIMESTAMP	DD/MM/YY HH24:MM:SS			PK	
	Task_Type	Type of task performed - can be either treatment (TRT) or checkup (CU)	VARCHAR2(3)	Xxx	TRT or CU			
Treatment	Patient_ID	Unique 5 digit patient identification number	NUMBER(5,0)	99999	10000-99999		PK/FK	Patients
	Treatment_Timestamp	Date and time of the treatment	TIMESTAMP	DD/MM/YY HH24:MM:SS			PK	
	Spec_WorkerID	Unique 4 digit worker identification number	NUMBER(4,0)	9999	1000-9999		FK	Specialists
	Treatment_Given	Type of treatment given based on medical condition	VARCHAR2(100)	Xxxxxx				
	Treatment_Advice	Treatment advice given to the patient	VARCHAR2(100)	Xxxxxx				
	Payable_Amount	Total cost of treatment	NUMBER(7,2)	99999.99	0-99999.99			
	Payment_Due	Amount of payment due	NUMBER(7,2)	99999.99	0-99999.99			
	Date_paid	Date payment is paid	DATE	DD/MM/YY		Y		
	Payment_Mode	Payment mode used (e.g. cash, debit, credit)	VARCHAR2(15)	Xxxxxx				
Check Up	Patient_ID	Unique 5 digit patient identification number	NUMBER(5,0)	99999	10000-99999		PK/FK	Patients
	Checkup_Timestamp	Date and time that the patient receives a check-up	TIMESTAMP	DD/MM/YY HH24:MM:SS			PK	
	Nur_WorkerID	Unique 4 digit worker identification number - from Nurses (in general staff)	NUMBER(4,0)	9999	1000-9999		FK	Nurses
Visits	Visit_ID	Unique 8 digit visitor identification number	NUMBER(8,0)	99999999	10000000-99999999		PK	
	Visit_Timestamp	Date and time of the visit	TIMESTAMP	DD/MM/YY HH24:MM:SS				
	Patient_ID	Unique 5 digit patient identification number	NUMBER(5,0)	99999	10000-99999		FK	Patients
	Visit_Type	Type of visit - can be either guest visit (GV) or patient check-in (PCI)	VARCHAR2(3)	Xxx	GV or PCI			
Guest Visit	GV_Visit_ID	Unique 8 digit visitor identification number - identified as a guest visit	NUMBER(8,0)	99999999	10000000-99999999		PK/FK	Visits
	Guest_FName	First name of the guest	VARCHAR2(20)	Xxxxxx				
	Guest_LName	Last name of the guest	VARCHAR2(20)	Xxxxxx				
	Guest_Contact	Contact number of the guest (e.g. landline or mobile number)	CHAR(10)	9999999999				
	Street_No	Street number (Address)	NUMBER(3,0)	999	0-999			
	Street	Street name (Address)	VARCHAR2(100)	Xxxxxx				
	Suburb	Suburb (Address)	VARCHAR2(100)	Xxxxxx				
	State	State acronym (Address)	VARCHAR2(3)	Xxx				
	Postcode	Postcode of the patient's residential address	NUMBER(4,0)	9999	1000-9999			
Patient Check-In	PCI_Visit_ID	Unique 8 digit visitor identification number - identified as a patient check-in	NUMBER(8,0)	99999999	10000000-99999999		PK/FK	Visits
	Spec_WorkerID	Unique 4 digit worker identification number - from specialists	NUMBER(4,0)	9999	1000-9999		FK	Specialists
Results	Visit_ID	Unique 8 digit visitor identification number	NUMBER(8,0)	99999999	10000000-99999999		PK/FK	Visits
	Cleared_Positive	Whether the visitor has been cleared positive following a positive COVID-19 test	VARCHAR2(3)	Xxx	YES or NO			
	Close_Contact_1	Whether the visitor has been in contract with a confirmed COVID-19 case in the past 14 days	VARCHAR2(3)	Xxx	YES or NO			
	Close_Contact_2	Whether the visitor has been formally identified as a close contact of a confirmed case	VARCHAR2(3)	Xxx	YES or NO			
	Symptoms	Whether the visitor is unwell with any cold or flu like symptoms	VARCHAR2(3)	Xxx	YES or NO			
	Hotspot_or_DTravel	Whether the visitor has travelled to an identified hotspot, returned from overseas or from a cruise in the last 14 days	VARCHAR2(3)	Xxx	YES or NO			

6. SQL QUERIES

QUERY 1

```
SELECT patient_ID AS "Person ID", patient_fname || ' ' || patient_lname AS "Full Name",
   street_no || ' ' || street || ', ' || suburb || ', ' || state || ', ' || postcode AS "Address"
FROM patients
WHERE patient_ID IN
(   SELECT DISTINCT patient_ID
   FROM visits
   WHERE visit_type = 'PCI' AND visit_timestamp > '01/JAN/2020'
);
```

QUERY 1 OUTPUT

	Person ID	Full Name	Address
1	17634	Janes Bond	72 Plug St., Black Mountain, NSW, 2365
2	25687	Subhan Dolan	88 Glenpark Rd., Minnie Water, NSW, 2462
3	56348	Joanne Reader	49 Friar John Way, LEDA, WA, 6170

QUERY 2

```
SELECT department_ID AS "Department ID",
   Dep_location AS "Location",
   Dep_name AS "Name",
   Dep_facilities AS "Facilities",
   Dep_description AS "Description"
FROM departments
WHERE department_ID IN
(   SELECT department_id
   FROM workers
   WHERE worker_id IN
   (   SELECT t_workerid
      FROM allocated
      WHERE lab_name = 'Sepsis Lab'
   )
);
```

QUERY 2 OUTPUT

	Department ID	Location	Name	Facilities	Description
1	102	A5	Admissions	(null)	Patients will provide personal information and sign consent forms – done by patient or family member

QUERY 3

```
SELECT worker_ID AS "Person ID", phone#
FROM workers
WHERE worker_id IN
(   SELECT spec_workerid
    FROM treatment
    WHERE patient_ID IN
    (   SELECT patient_ID
        FROM patients
        WHERE patient_fname = 'Thomas' AND patient_lname = 'Koon'
    )
);
```

QUERY 3 OUTPUT

	Person ID	PHONE#
1	1929	0490123456

QUERY 4

```
SELECT patient_id AS "ID", patient_fname || ' ' || patient_lname AS "Name", discount_rate
AS "Discount Rate"
FROM patients
WHERE patient_id IN
(   SELECT patient_id
    FROM residents
    WHERE patient_id IN
    (   SELECT patient_id
        FROM treatment
        WHERE spec_workerID IN
        (   SELECT spec_workerID
            FROM specialists
            WHERE specialty = 'Cardiovascular Disease'
        )
    )
);
```

QUERY 4 OUTPUT

	ID	Name	Discount Rate
1	12356	Thomas Koon	10

QUERY 5

```
SELECT t.patient_ID AS "Patient ID",
   ds.ds_timestamp AS "Visit Timestamp",
   t.task_timestamp AS "Activity",
   t.task_type AS "Activity Type"
FROM tasks t
INNER JOIN day_surgery ds
ON t.patient_ID = ds.patient_ID
WHERE t.task_timestamp > '31/DEC/2019' AND t.task_timestamp < '01/JAN/2021';
```

QUERY 5 OUTPUT

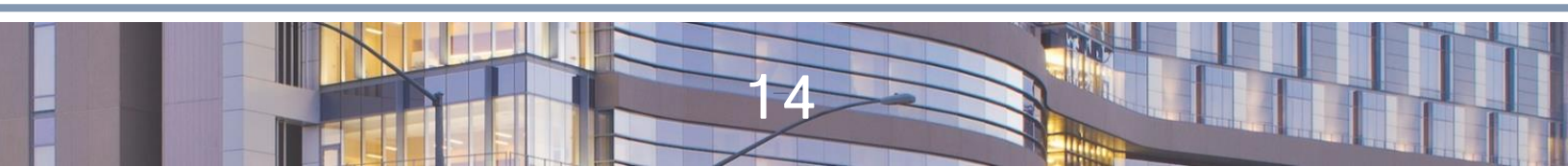
	Patient ID	Visit Timestamp	Activity	Activity Type
1	17634	16/OCT/20 07:00:00.000000000 AM	16/OCT/20 08:00:00.000000000 AM	CU
2	56348	15/MAR/20 11:00:00.000000000 AM	24/MAR/20 11:00:00.000000000 AM	TRT
3	93674	19/MAY/20 02:00:00.000000000 PM	19/MAY/20 11:00:00.000000000 AM	TRT
4	93674	19/MAY/20 02:00:00.000000000 PM	19/MAY/20 10:00:00.000000000 AM	CU

QUERY 6

```
SELECT COUNT(DISTINCT(room_number || '-' || building_id)) AS "Room Count"
FROM beds
WHERE bed_id IN
(   SELECT bed_id
   FROM residents
   WHERE payment_due = 0 AND date_paid >= '01/JAN/2020' AND date_paid <=
'12/JAN/2020'
);
```

QUERY 6 OUTPUT

	Room Count
1	3



QUERY 7

```
SELECT guest_fname || ' ' || guest_lname AS "Guest Name",
   guest_contact AS "Guest Contact"
FROM guest_visit
WHERE gv_visit_id IN
(  SELECT visit_id
   FROM visits
   WHERE visit_type = 'GV' AND visit_id IN
   (  SELECT visit_id
      FROM results
   )
);
```

QUERY 7 OUTPUT

	Guest Name	Guest Contact
1	Jason Khu	0411111111
2	Jacky Li	0422222222
3	Chloe Tam	0433333333
4	Wendy Chau	0444444444
5	Johnnie Pham	0455555555
6	Maruigi Powser	0499999999

QUERY 8

```
SELECT p.patient_id AS "Patient ID",
   SUM(t.payable_amount - t.payment_due) AS "Total Treatment Payments"
FROM patients p
INNER JOIN treatment t
ON p.patient_id = t.patient_id
WHERE p.age > 30 AND p.gender = 'F'
GROUP BY p.patient_id;
```

QUERY 8 OUTPUT

	Patient ID	Total Treatment Payments
1	56348	225

7. DISCUSSION

7.1: NOTEWORTHY FEATURES

To guarantee that the SGHHMS achieves the objective of operational efficiency and user accessibility, implemented features are integrated into the system. Primary functions revolve around the design of the SGHHMS and its inclusion of multi-user accessibility, security mechanisms, check constraints and COVID tracking.

Multi-user accessibility

The primary objective of designing and implementing a DBMS is to capitalise on the centralisation of easily updated datasets (Rathinaswamy & Pichandy, 2017). Considering the SGHHMS can be accessed from different locations using different hardware, it offers a multi-user function that can facilitate increased operational efficiency for internal stakeholders. This will enable a non-rival experience for staff to input relevant data and thus, allow for more swift and accurate datasets compared to other systems. Holistically, this will improve operational efficiency through user accessibility as well, as the ability to extract updated data quickly will allow for general staff to treat patients at a greater standard.

Security Mechanisms

To ensure that multi-user accessibility does not cloak the issues of data breaches and unauthorized access to the DBMS, the SGHHMS has implemented coordinate tracking to monitor access. By integrating the map coordinates of key entities like department, buildings and laboratories, anomalies of map coordinates belonging unknown individuals can be highlighted. This consequently forms the infrastructure of administrative and IT staff to monitor the security of the SGHHMS and sustain future efforts of addressing ethical issues (explained in 7.3.1).

Check Constraints

To ensure that data is valid and to reduce the probability of data duplication, the SGHHMS has implemented check constraints that specify the range of attributes. This is necessary to align the DBMS with the range specified in the Data Dictionary, and thus, enforce the cohesiveness of the SGHHMS as a centralised system. Check constraints, therefore, ensure that the integrity of the DBMS is upheld while offering a sense of operational efficiency for the storage of data.

COVID-19 Tracking and Scalability

The recent necessity to track movements of patients and visitors if they come into contact with SGHPH has been incorporated into the SGHHMS. By forming new entities, relationships and attributes related to COVID tracking, SGHPH will be able to seamlessly align with government regulations. As this may be expected to be wield high quantities of data (as all individuals must be screened), the SGHHMS will minimize configurations by simplifying results (as shown in Data Dictionary). Furthermore, SGHHMS will be able to remove attributes related to COVID tracing after 30 days. This reflects the SGHHMS' ability to remain streamlined and effective in being scalable internally in the long run.

7.2: FUTURE IMPROVEMENTS

To ensure that SGHPH remains its reputation in providing quality services for its patients, updating the SGHHMS based on industry trends is essential in increasing the specialization of medical assistance. Currently, there is a niche for the extraction of data, which can be utilised alongside business intelligence. Continuum Consultants have identified the personalization of services and the monetization of data as justifiable reasons for such a notion (Deloitte, 2020). Furthermore, as there is an upward trend for database that bridge SQL and NoSQL (Atlas Systems, 2020), SGHPH should look to further develop its DBMS to expand its database capabilities.

Business Intelligence

Similar to consumer trends, there is a public demand for the personalization of services present in the healthcare industry (Boudet et al, 2019). In regard to the SGHPH, this will require the ability to derive information which caters a higher level of transparency, convenience, access, and personalization for their patients (Deloitte, 2020). To do so, Continuum Consultants recommends the SGHHMS to operate alongside business intelligence, where datasets within the DBMS are analysed.

Additionally, such infrastructure can also support the industry trend of monetizing data. By storing de-identified advanced data about patients, SGHPH possesses detailed insights on future niches that may be present in the medical sector. By monetizing such data to experts, SGHPH can therefore obtain a second income stream while gauging a competitive advantage through potential innovations derived from their provided datasets. By storing, not only the medical history of patients but also their level of comfort when interacting with SGHPH, future personalization of service can be implemented. This will be effective in providing service for returning patients, or patients with serious conditions, as the SGHPH can immediately cater to their needs without specific requests by patients. Furthermore, this will enable for more streamlined convenience and accessibility for SGHPH's patients. This will indefinitely distinguish SGHPH as a quality provider of healthcare that cares for its people.

However, if the SGHPH is to pursue business intelligence, expanding the database is necessitated. The SGHHMS must be able to integrate more attributes (which relate to patient satisfaction) and more entities (relating to the provision of care packages) into the DBMS.

SQL and NoSQL

With the consideration of expanding the ebase and an expectation of a higher volume of data to be processed, SGHPH may look to bridge SQL with NoSQL. By using both, the SGHHMS will be more adept in handling unpredictable and unstructured data due to an increased level of agility and scalability (Datawarehouse concepts, 2016). This will be particularly optimal for SGHPH if it decides to align with medical industry trends and utilise business intelligence. In referral to the DBMS and its relational structure, Continuum Consultants believes that it is only effective for transactional enterprise applications due to its immediate and rigid data consistency (Rouse, 2011). Thus, by bridging both applications, SGHPH will be able to retain a strong database for its internal processes, while venturing to the personalization of service niche that will grant it a competitive advantage.

7.3: ETHICAL ISSUES AND CONSIDERATIONS

7.3.1: Data breaches and database security

The primary risk of a centralised database like the SGHHMS is its vulnerability and access management difficulties (Quantin et al, 2011). According to industry trends, Australia's health sector accounted for 22% of all data breaches between July – December 2019 (Tsirtsakis, 2020). Thus, it is apparent that the personal information of patients, can be subjected to issues like informational leakages, cyber-hacking and internal fraud if insufficient security measures are not implemented.

To mitigate potential risks, it is essential that substantial efforts to implement defensive infrastructure is prioritised. Statistically only a third of Australian organisations embed cyber security awareness and training into their policies and procedures (Tsirtsakis, 2020). SGHPHS should implement a systemic process which aims to **train internal stakeholders (1)** and **monitor access and behaviour (2).**

Training internal stakeholders

Internal stakeholders will be required to follow standard procedures to ensure that the SGHHMS remains safe from issues of information leakages and internal fraud. To maintain the cohesiveness of the DBMS, it is required that all stakeholders notify it on every operation they make in day-to-day activities (Quantin et al, 2011). This is because, due to the large size of SGHPH, it will be extremely difficult to track anomalies and changes in data. Thus, if small actions like the prescription of drugs to patients are not recorded, it will be harder to track data manipulations done by external threats.

Furthermore, new employees must be trained to use stronger usernames and passwords and are recommended to update it frequently. Past employees will be denied access to the SGHHMS to ensure that the data is only used strictly for procedures within SGHPH.

Monitor access and behaviour

According to study, 30% of data breaches incidence is human negligence (Maurer, 2015). By monitoring all database access activity and usage patterns, such negligence can be mitigated. Furthermore, as mentioned previously, by removing excessive privileges and aligning access rights with occupancy, the confidentiality of patient data will be more sufficiently upheld.

7.3.2: Data transparency and consent

The public consensus on information systems and the retainment of personal data is negative, with 73% of consumers stating that they are concerned about their privacy, and 20% stating that corporations do not care about privacy (Jackson, 2019). Considering SGHPH aims to provide a high quality of service for their patients, this ethical concern should be considered.

In SGHPH, patient data may be referred for health research or as precedent for future operations. Traditionally, consent is not needed for datasets that have been de-identified. However, it is probable that sensitive data regarding to patient identity may still be accessed during the stages of de-identification. Considering the SGHHMS is centralised, patient data and their sensitive data may be used for unknown reasons by personnel with access (*like those mentioned in 7.2*). To ensure that patients are comfortable with their information being used for medical reasons, SGHPH may aim to ask for consent when storing data into the SGHHMS. Furthermore, by underlining how the SGHHMS operates and how data is collected and used for, it ensures that the transparency of data is sustained and promotes positive external perceptions of the SGHHMS.

8. CONCLUSION

The design and implementation of the SGHHMS will increase the level of operational efficiency and user accessibility within SGHPH. With the primary focus on a dynamic and accurate DBMS, Continuum Consultants aim to uphold standards of quality through more streamlined medical services. This ensures that SGPH can continue the provision of medical services with the primary focus on patient satisfaction and care.

9. CRITICAL REFLECTION

Task Delegation

To ensure that tasks were divided equally, each person was assigned to be responsible for one key objective of this project (refer to Figure 2). This also ensured that all aspects of the project were sufficiently analyzed and completed as everyone was held accountable to a standard of quality. To ensure that all members were comfortable with their responsibility and their capability to take the lead on the project, roles were delegated based on strength and personal preferences. According to figure 4, all members had positive ratings of this practice, with an average of **4.4/5.** Thus, indicating that this system was able to successfully align the skills of members with tasks, while being sufficient in completing our group project. Additionally, quantitative data shown in figure 3 suggests that our method of delegating tasks were unanimously perceived to have distributed the workload relatively evenly.

However, our team recognized from an early stage that our method may have its flaws. The main issue identified was the potential discrepancy in how every member would have analyzed the case scenario, which may have minimized the cohesiveness of our overall report. Thus, it was a priority for us to formulate methods of team collaboration during the initial stage of our project.

Team Collaboration

Our methods of collaboration aimed to be dynamic with weekly meetings being held on Microsoft Teams with an agreed time and minor meetings being held in-person. The hybrid nature of our meetups evidently was a success with figure 5 indicating an average score of **4.6/5**. By mixing methods of communication, we were able to capitalise on the benefits of brainstorming on both platforms. Our in-person meetings that often commenced during the weekdays aimed to create personal bonds between members, while being an opportunity to share ideas and perceptions of the case. On the other hand, our online meetings aimed to track progress of each section and were solely commenced for time management reasons. Despite the effectiveness of our meetings, it was apparent that availability was a major drawback. According to figure 6, it is evident that meeting times were not optimal for many of our members. This is observed through the lack of full attendance for in-person meetings, that may have reduced the overall cohesiveness of our project.

Furthermore, we utilised communication platforms like Facebook Messenger, which aimed to be a passive way of collating ideas and progress. However, it is evident that a future improvement of team practices would be a greater emphasis on team availability. By using applications like ‘when2meet’ more consistently throughout the project, this issue may be minimized.

Time Management

The structure of our practices was dependent on the ability of all members to possess effective time management skills. Considering the collective trust that all members will meet deadlines, our timeline for this project was fairly simple. Referring to Figure 1, all members were given a block of time (14 days) to ensure that their sections were complete. However, as time progressed, we recognised that some parts (in particular) the ERD required more time to finalise. As other tasks were contingent on the completion of the ERD, this extended our deadline. To mitigate this, we initiated an urgent meeting on November 4th, where all members collaborated on the ERD with high levels of discussion. This enabled the process to move along quicker and allowed for us to remain within our deadlines.

Thus, in the future, we look to incorporate this aspect of collaboration in our weekly meetings. In regards to the ERD for example, it may have been optimal to collaborate on such task on the initial stage so that the individual responsible for its completion can accurately reflect the cohesive perception of the case into the diagram.

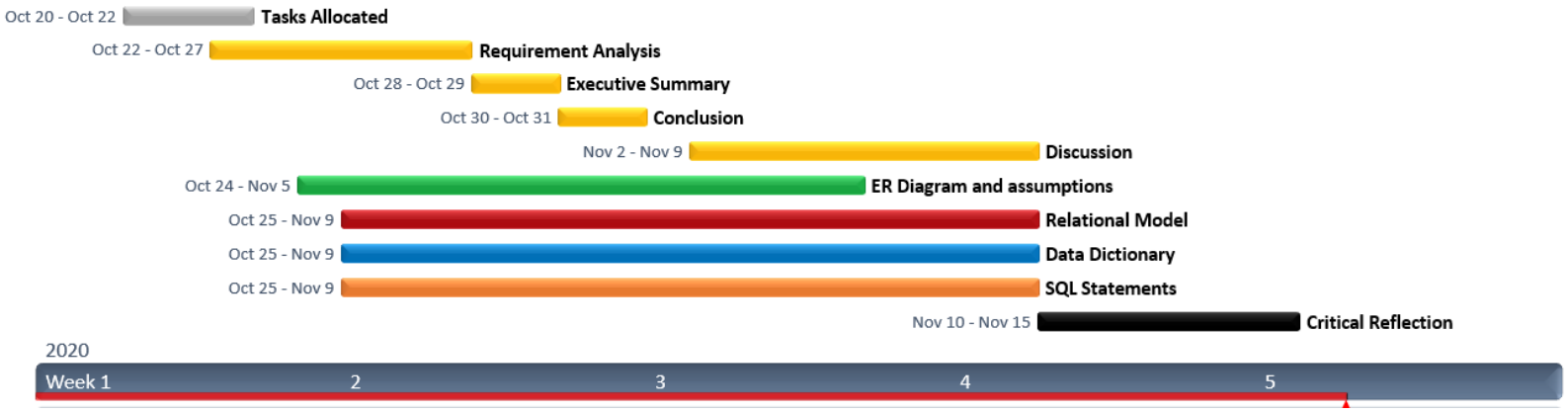


FIGURE 1: Timeline

Chloe Tam	• **ERD Diagram and assumptions**
Jason Khu	• **SQL queries** =
John Pham	• **Writing related tasks**: - Executive summary - Requirement Analysis - Discussion - Critical Reflection = Format report
Xinyu Li	• **Relational Model and analysis**
Wendy Chau	• **Data Dictionary**

FIGURE 2: Initial Task Delegation

Note: All surveys were done anonymously

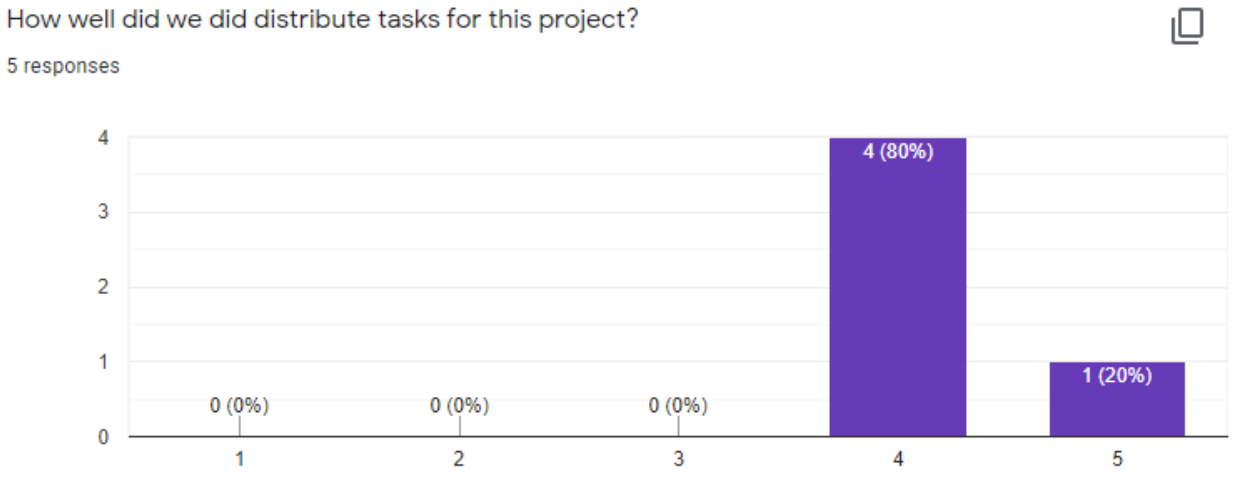


FIGURE 3: Review of delegation

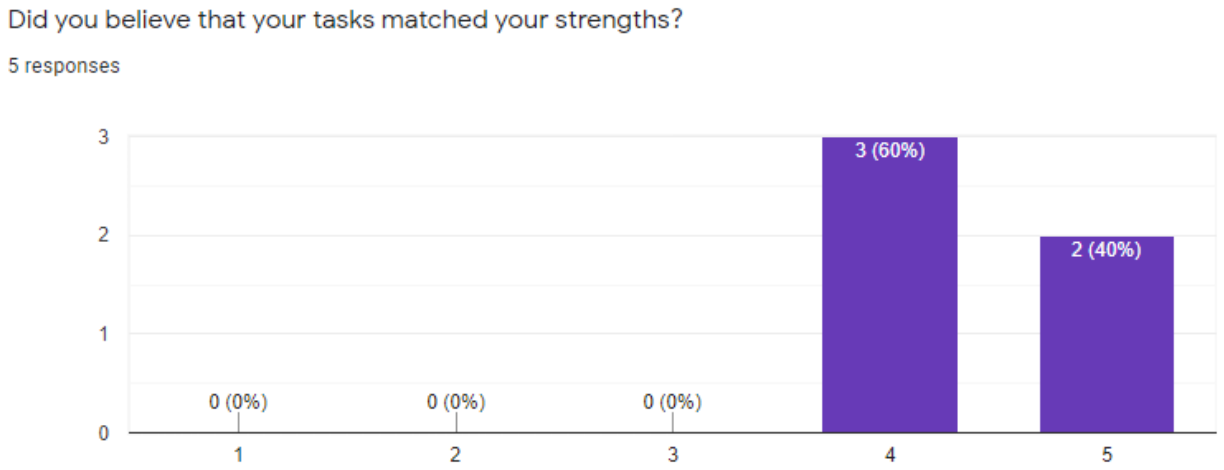


FIGURE 4: Satisfaction of role

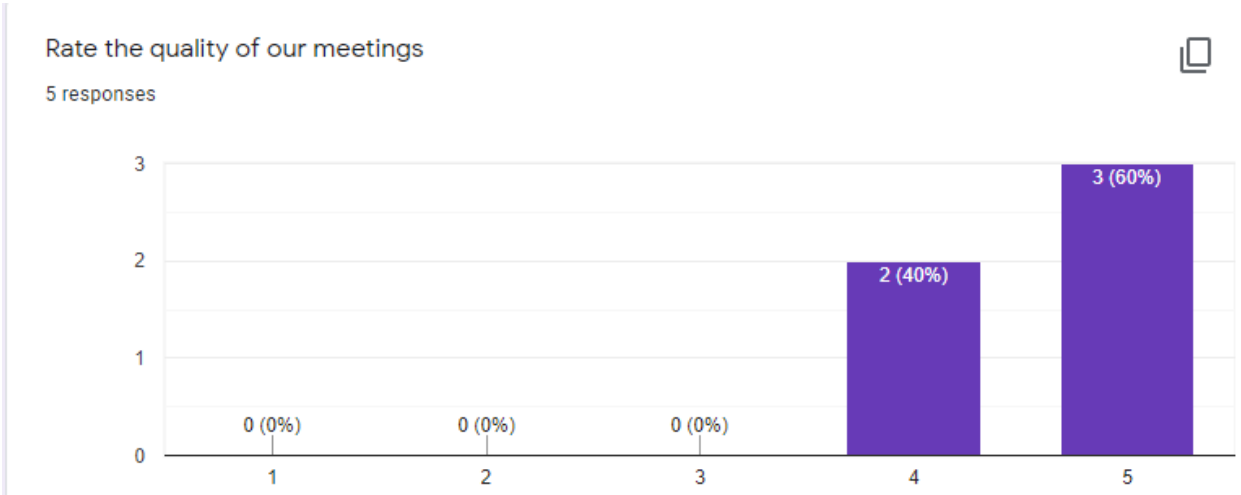


FIGURE 5: Meeting Quality

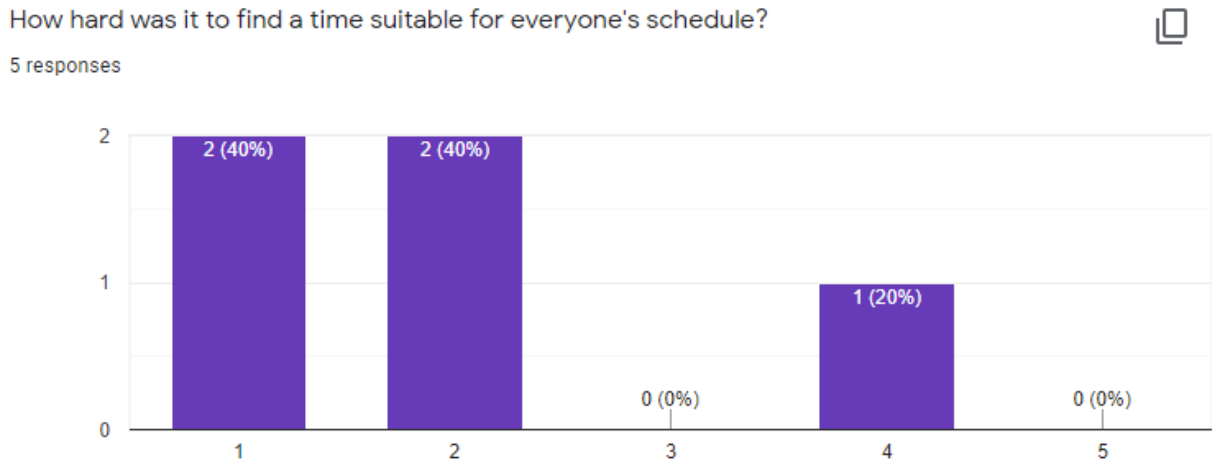


FIGURE 6: Schedule

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