UTM

UNIVERSITI TEKNOLOGI MALAYSIA

SECD 2523 - DATABASE

SEMESTER I, SESSION 2023/2024

Phase 3: Database Conceptual Design

E-Clinic System

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Section 08

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Introduction

This phase 2 document will focus on the development of the logical design of the E-Clinic system. In this phase, the proposed solutions described in phase 1 will be defined using Data Flow Diagram and Entity Relationship Diagram following a proposed business rule.

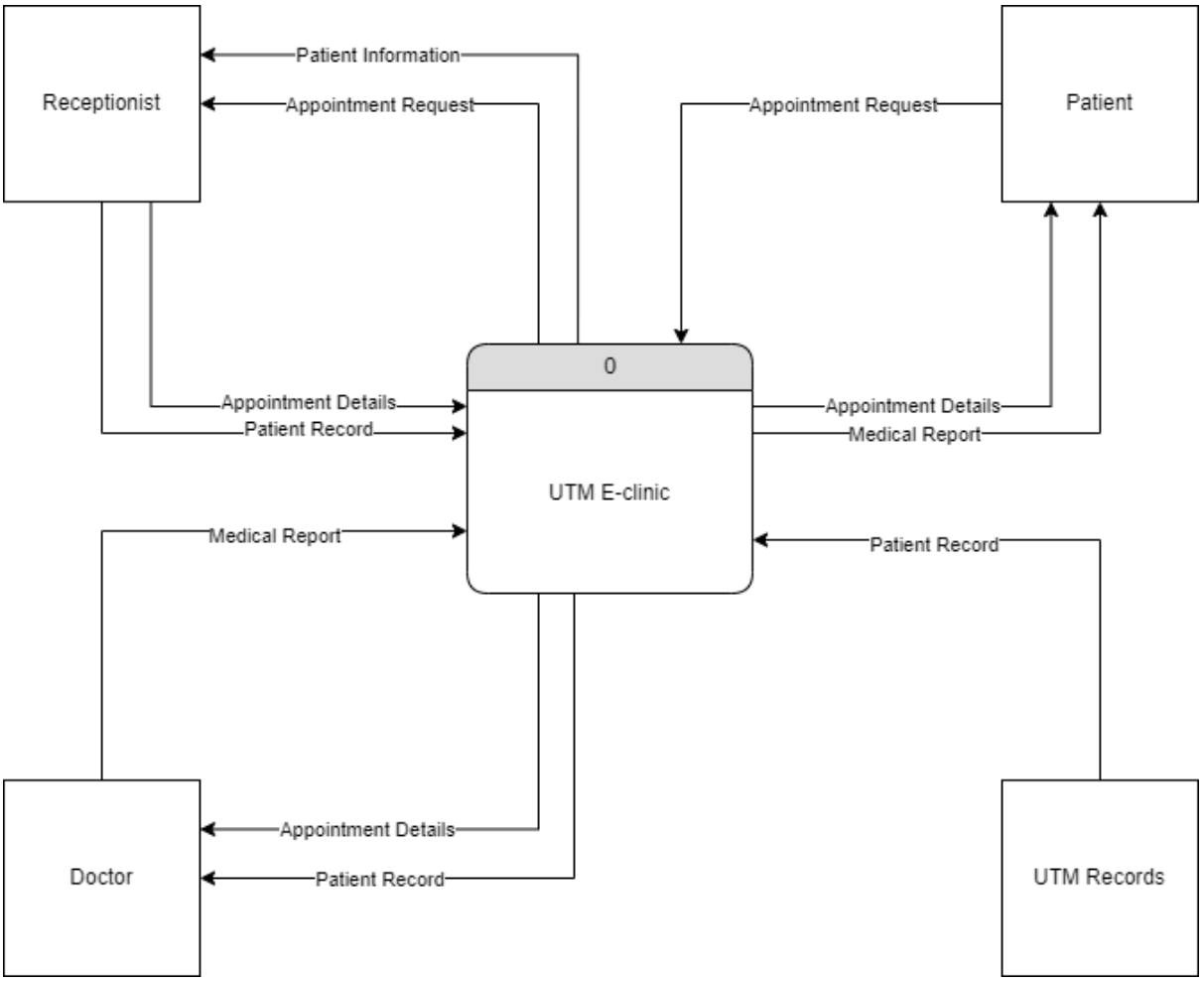
The Data Flow Diagram will be used to track which data from which actors that will flow through the system. The DFD will visualize the data from and to the external entities and the system itself. This includes primary data flow described in Context Diagram which will be expanded in the level 0 DFD where data from external entities will interact with the main system, that will be expanded into DFD level 1 where interactions with each subsystem will be defined in detail.

After making the DFD, the business rule will be defined in order to make the ERD. The business rule in this document will include business policies and constraints. After the business rule, the Entity Relationship Diagram to show the interaction of entity and system. The ERD is followed by an Enhanced ERD where the entities and its relation will be defined further.

At the end of the document, the entity and data that has been defined in the ERD will be listed in a Data Dictionary which will give the specifications such as data type, constraints, data length. This data dictionary will be used during the physical implementation.

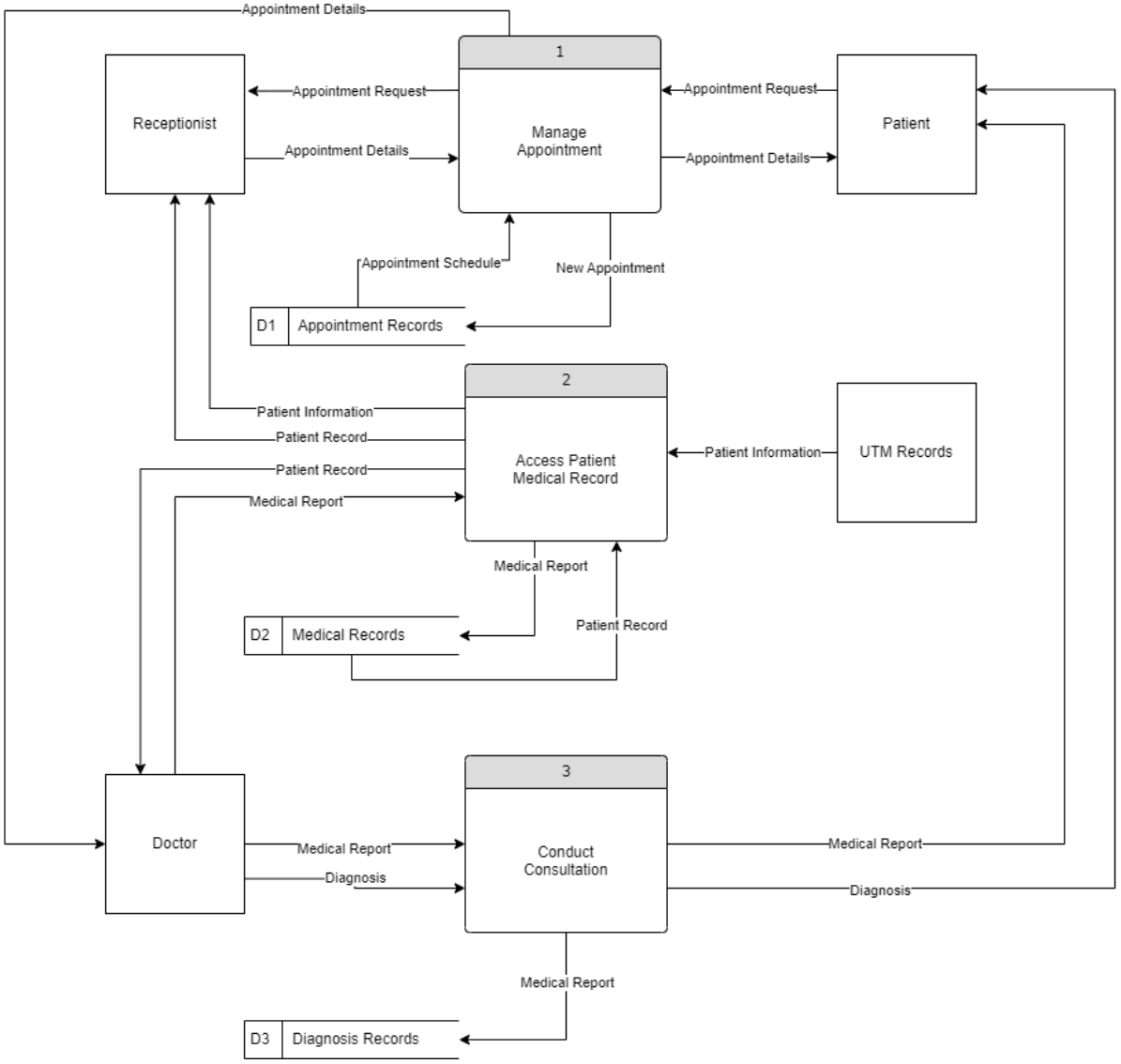
DFD

1.1. Context Diagram



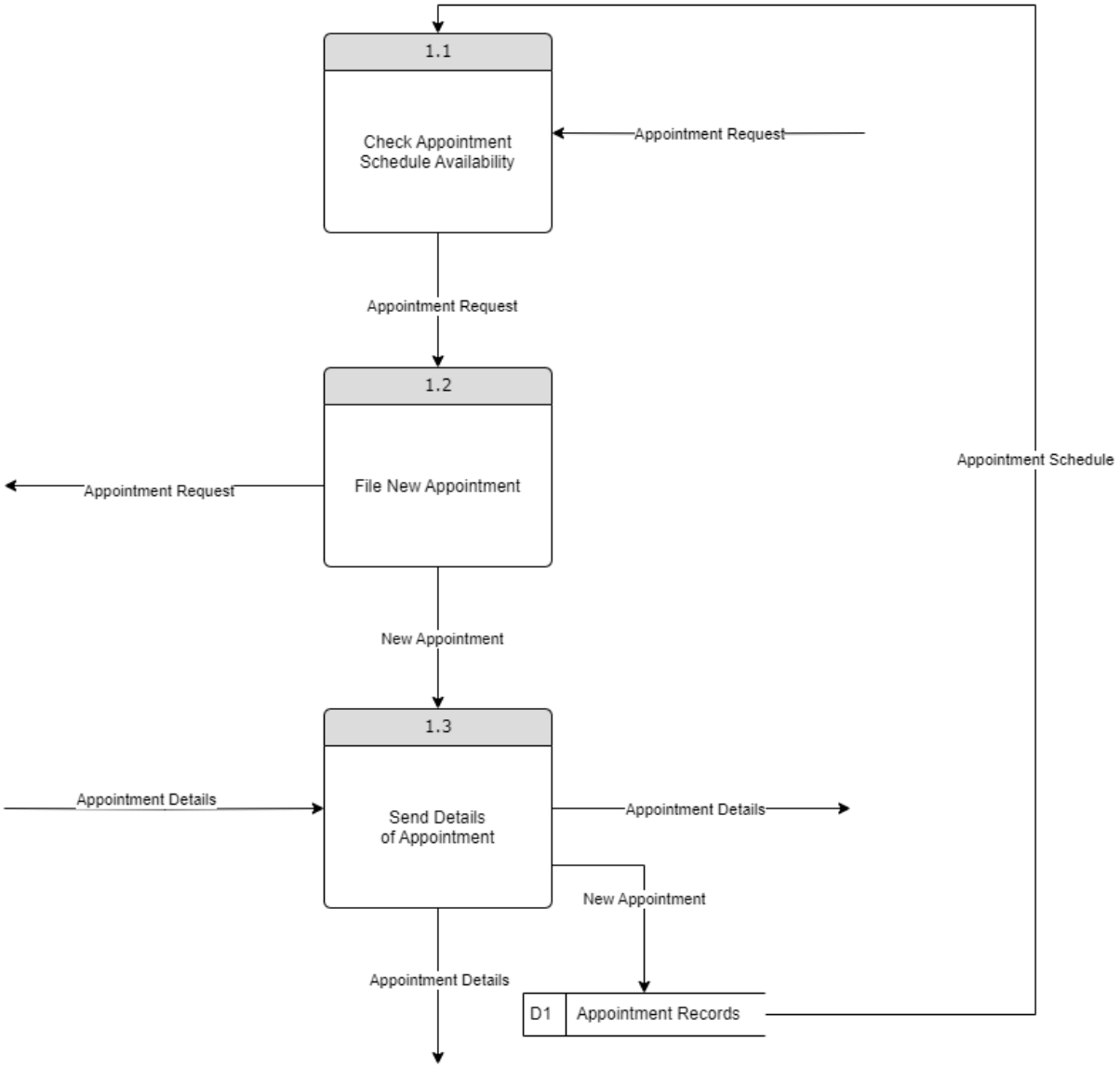
Actor: Doctor, Patient/Student , Pharmacist, Receptionist

1.2. Diagram Level 0

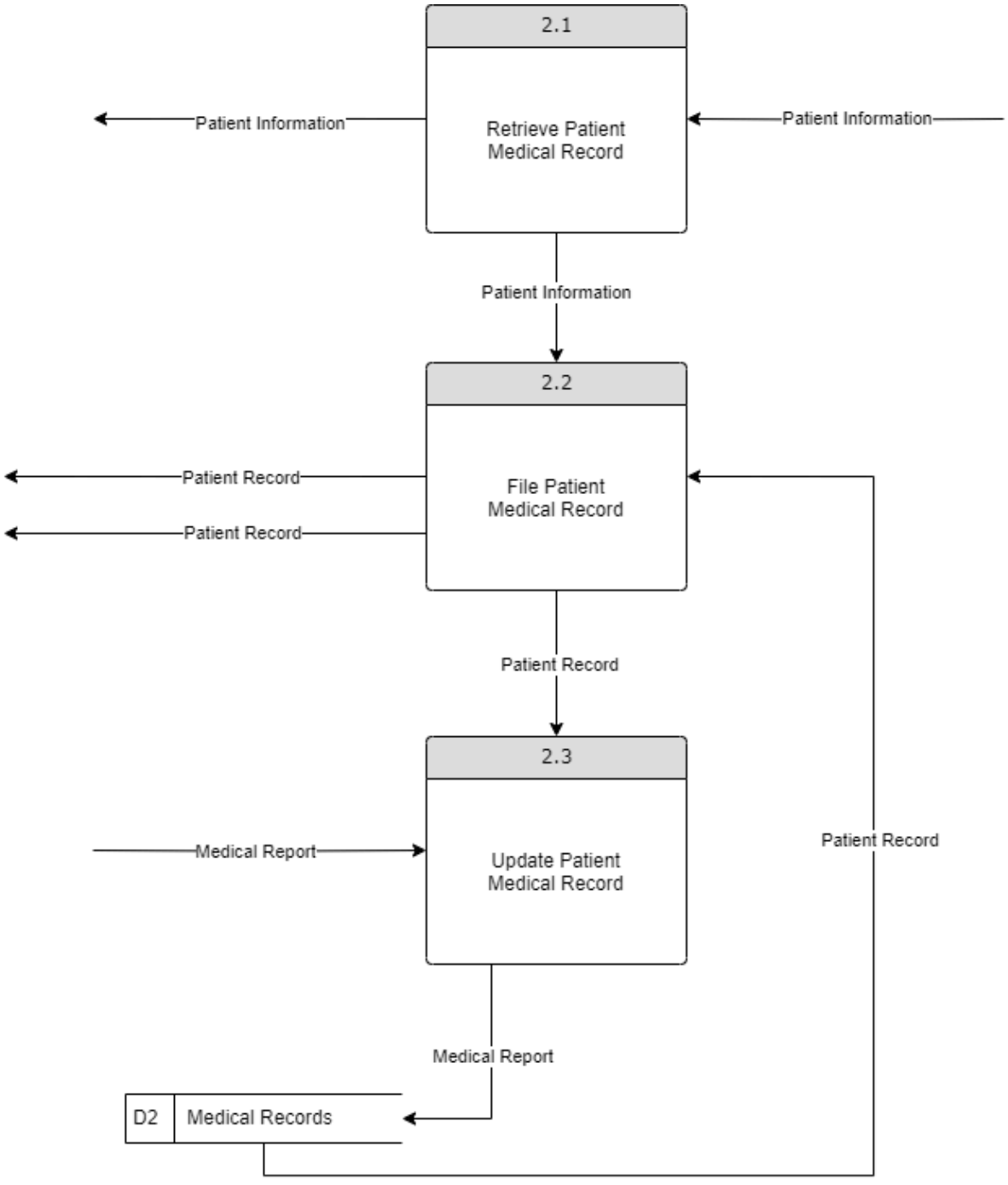


1.3. Diagram Level 1

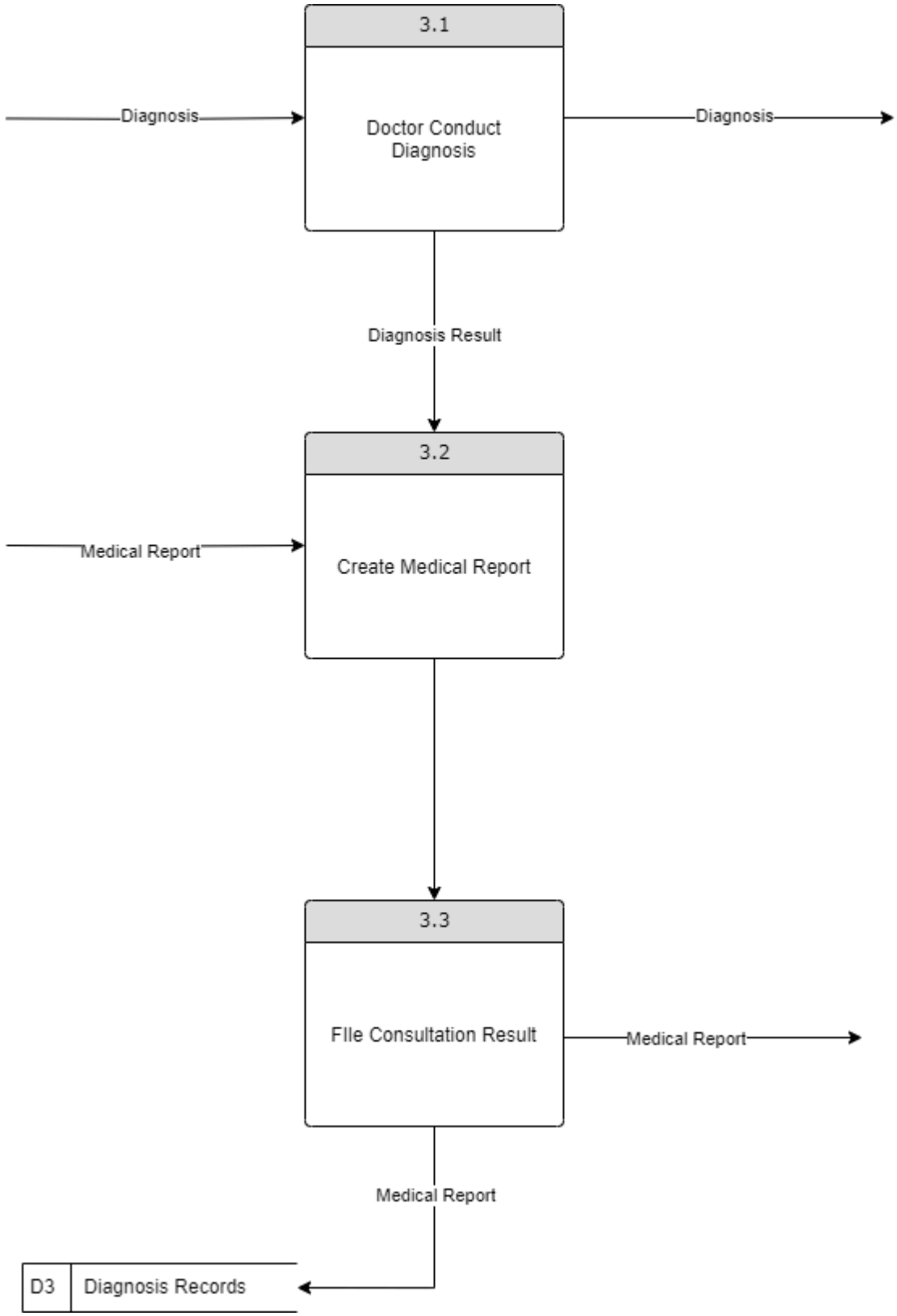
1.3.1. Manage Appointment



1.3.2. Access Patient Medical Record

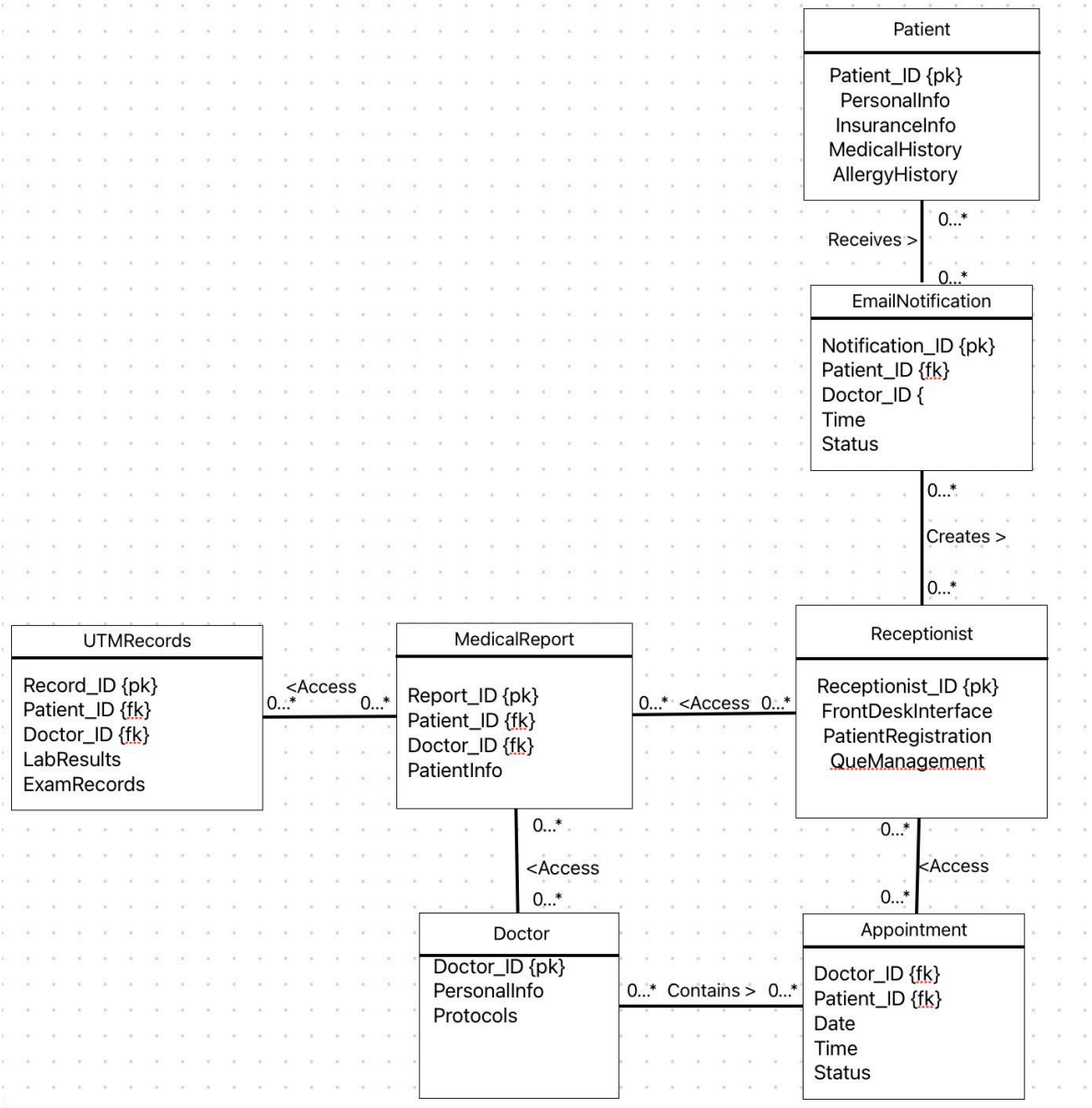


1.3.3. Conduct Consultation

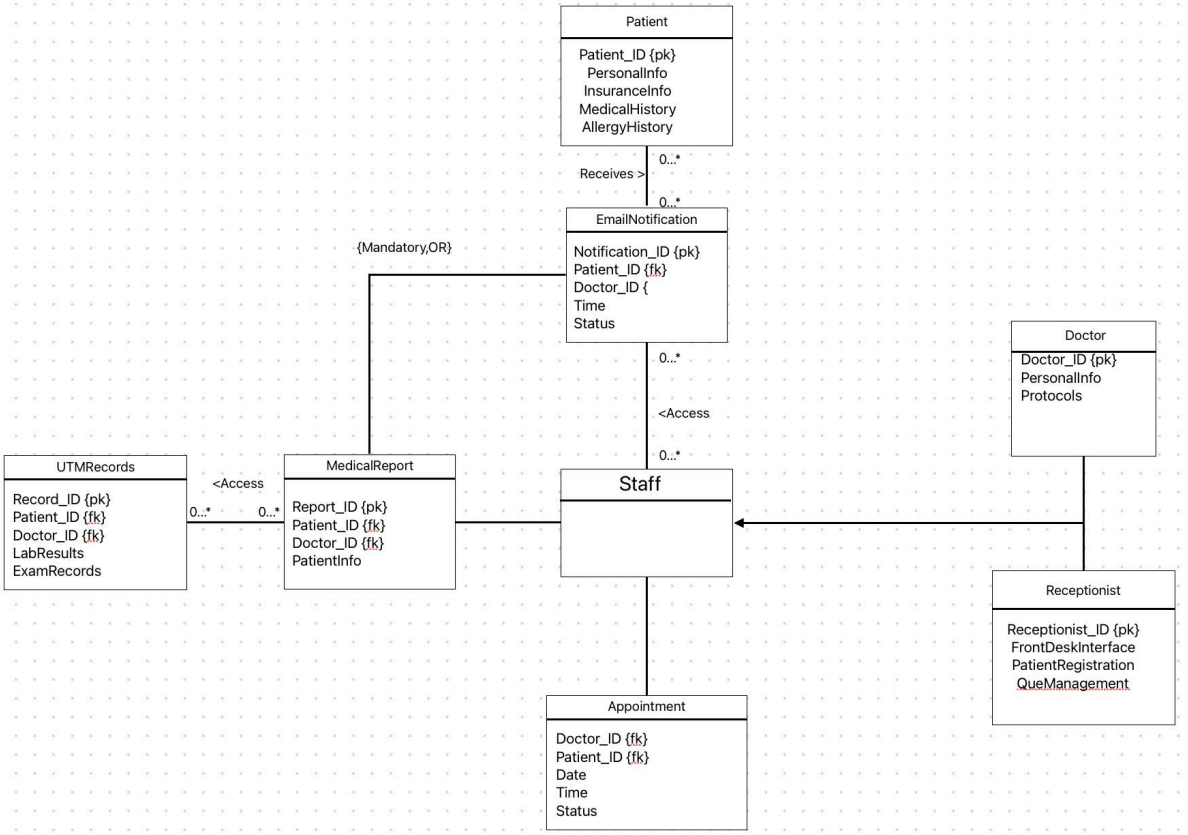


Database conceptual design

1.4. Conceptual ERD



1.5. Enhanced ERD (EERD)



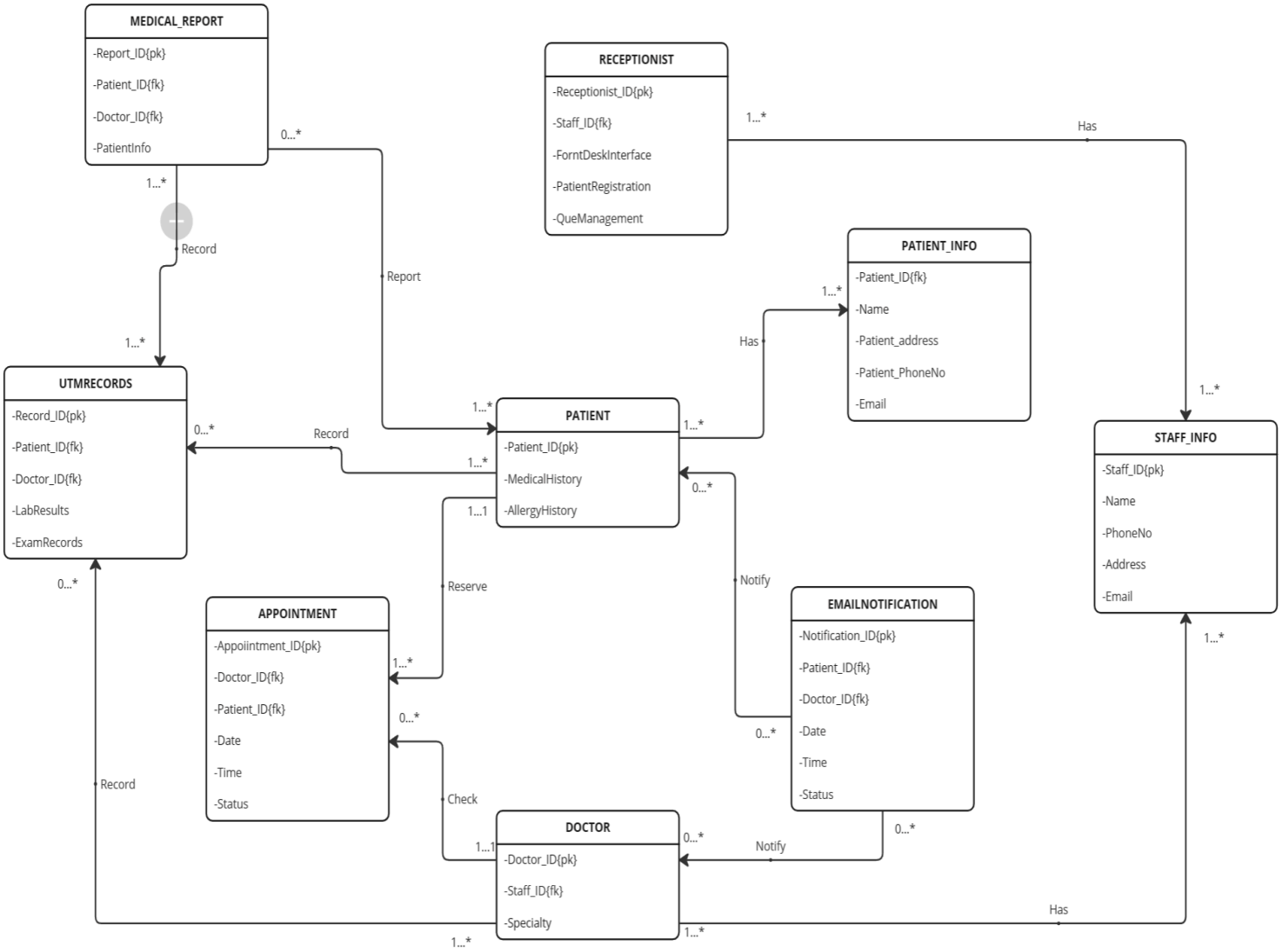
1.6. Database Logical design

Strong Entities:

- Patient
- Doctor
- Staff Info
- UTMRecords
- MedicalReport
- Appointment
- EmailNotification

Weak Entities:

- Patient Info



4. Data dictionary

Our data dictionary provides a clear guide to the elements within your database. It details each table's attributes, including their data types, lengths, and specifications, helping users understand and manage the database efficiently

4.2.1 Description of Entity

Entity	Description	Occurrence
MEDICAL_REPORT	Contains records of medical reports generated for patients	One record per patient
UTMRECORD	Stores universal medical records including exam and lab results	Multiple records per patient, as needed
APPOINTMENT	Holds information about appointments scheduled for patients	Multiple entries possible for patients, one per appointment
PATIENT	Represents the patients who receive medical services	One record per patient
DOCTOR	Information about doctors providing medical services	One record per doctor
EMAILNOTIFICATION	Description: Tracks email notifications sent to patients regarding appointments	Multiple possible, one for each notification sent
PATIENT_INFO	Detailed information about patients	Occurrence: One record per patient, containing contact details
STAFF_INFO	Details of the medical and administrative staff	One record per staff member
RECEPTIONIST	Information about receptionists at the medical facility	One record per receptionist

4.2 Description of Relationship

Entity	Multiplicity (Entity side)	Relationship	Multiplicity (Related Entity side)	Related Entity
MEDICAL_REPORT	1...1	Is Recorded In	0..*	UTMRECORDS
UTMRECORDS	1...1	Records	1..*	MEDICAL_REPORT
APPOINTMENT	1...1	Belongs To	1...1	PATIENT
PATIENT	1...1	Has	1...1	PATIENT_INFO
PATIENT_INFO	1..*	Belongs To	1...1	PATIENT
DOCTOR	1...1	Is Notified By	0..*	EMAILNOTIFICATION
EMAILNOTIFICATION	1...1	Notifies	1...1	DOCTOR
RECEPTIONIST	1...1	Manages	1..*	APPOINTMENT
PATIENT	1...1	Has an Appointment	1..*	APPOINTMENT
DOCTOR	1...1	Has an Appointment	1..*	APPOINTMENT
STAFF_INFO	1...1	Is	1...1	DOCTOR
STAFF_INFO	1...1	Is	1...1	RECEPTIONIST

4.3 Description of Attributes

Entites	Attributes	Description	Data type	length	Null allowed?	Mult value
Patient	Patient ID	Unique identifierfro each patient	integer	10	No	No
	personalInfo	Full informationof for each patient	Varchar	30	Yes	Yes
	insuaranceinfo	Full breakdown of policy and term	Varchar	30	Yes	Yes
	medicalHistory	Encompass complete full health deatails	Varchar	30	Yes	Yes
	AllergyHistory	Listing allergens	varchar	30	Yes	Yes
EmailNotification	Notification_ID (PK)	Unique identifier for each notification	Interger	10	No	No
	Patient_ID	Identification for the patient receiving the notification	Varchar	10	No	No
	Doctor_ID	Identification for the doctor associated with the notification	Varchar	30	Yes	No
	Time	Timestamp indicating when the notification was sent		30	No	No
	Status	Indicates the current status of the notification	varchar	30	No	No
Receptionist	Receptionist_ID (PK)	Unique identifier for each receptionist	Integer	10	No	No
	FrontDeskInterface	Capability or access level for the front desk interface	Varchar	30	Yes	No
	PatientRegistration	Capability or access level for patient registration tasks	Varchar	30	Yes	No
	QueueManagement	Capability or access level for managing queues or appointments	varchar	30	Yes	no

MedicalReport	Report_ID (PK)	Unique identifier for each medical report	Integer	10	No	No
	Patient_ID (FK)	Foreign key linking to the specific patient associated with the report	Integer	10	No	No
	Doctor_ID (FFK)	Foreign key linking to the specific doctor associated with the report	Integer	10	No	No
	PatientInfo	Field storing additional patient information related to the report	Varchar	30	Yes	No
UTMRecords	Record_ID (PK)	Unique identifier for each UTM record	Integer	10	No	No
	Patient_ID (FK)	Foreign key linking to the specific patient associated with the record	Varchar	30	No	No
	Doctor_ID (TK)	A technical key (TK) for the doctor associated with the record	Varchar	30	Yes	No
	LabResults	Field to store laboratory test results	Varchar	30	Yes	No
	ExamRecords	Field to store additional examination records or details	Varchar	30	Yes	No
Appointment	Doctor_ID (K)	Unique identifier for the doctor associated with the appointment	Integer	10	No	No
	Patient_ID (UKR)	Unique key reference for the patient associated with the appointment	Varchar	30	Yes	No
	Date	Date of the scheduled appointment	Varchar	30	Yes	No
	Time	Time of the scheduled appointment	Varchar	30	Yes	No
	Status	Indicates the current status of the appointment	varchar	30	Yes	No

Doctor	Doctor_ID (PK)	Unique identifier for each doctor	Integer	10	No	No
	Personalinfo	Field storing personal information about the doctor	Varchar	30	Yes	No
	Protocols	Field storing specific protocols or guidelines associated with the doctor's practice	varchar	30	yes	No

4.3 Normalization

PATIENT_INFO

FD: Patient_ID → Name, Patient_address, Patient_PhoneNo, Email

1NF&2NF&3NF&BCNF: PATIENT_INFO (Patient_ID, Name, Patient_address, (Patient_PhoneNo, Email

DOCTOR

FD: Doctor_ID → Staff_ID, Specialty

(1NF&2NF&3NF&BCNF: DOCTOR (Doctor_ID, Staff_ID, Specialty

**

STAFF_INFO

FD: Staff_ID → Name, PhoneNo, Address, Email

(1NF&2NF&3NF&BCNF: STAFF_INFO (Staff_ID, Name, PhoneNo, Address, Email

APPOINTMENT

FD: Appointment_ID → Doctor_ID, Patient_ID, Date, Time, Status

1NF&2NF&3NF&BCNF: APPOINTMENT (Appointment_ID, Doctor_ID, Patient_ID, Date, (Time, Status

EMAIL_NOTIFICATION

FD: Notification_ID → Patient_ID, Doctor_ID, Date, Time, Status

1NF&2NF&3NF&BCNF: EMAIL_NOTIFICATION (Notification_ID, Patient_ID, Doctor_ID, (Date, Time, Status

MEDICAL_REPORT

FD: Report_ID → Patient_ID, Doctor_ID, PatientInfo

:1NF&2NF&3NF&BCNF

(MEDICAL_REPORT (Report_ID, Patient_ID, Doctor_ID, PatientInfo

UTMRECORDS

FD: Record_ID → Patient_ID, Doctor_ID, LabResults, ExamRecords

NF&2NF&3NF&BCNF: UTMRECORDS (Record_ID, Patient_ID, Doctor_ID, LabResults, (ExamRecords

PATIENT

FD: Patient_ID → MedicalHistory, AllergyHistory

(1NF&2NF&3NF&BCNF: PATIENT (Patient_ID, MedicalHistory, AllergyHistory

5.0 Relational Database Schemas (Normalized Table)

This is the set of relation schemas in the relational database of the E-Clinic System database.

MEDICAL_REPORT (Report_ID, Patient_ID, Doctor_ID, PatientInfo)
UTMRECORD (Record_ID, Patient_ID, Doctor_ID, LabResults, ExamRecords)
APPOINTMENT (Appointment_ID, Doctor_ID, Patient_ID, Date, Time, Status)
PATIENT (Patient_ID, MedicalHistory, AllergyHistory)
DOCTOR (Doctor_ID, Staff_ID, Specialty)
EMAILNOTIFICATION (Notification_ID, Patient_ID, Doctor_ID, Date, Time, Status)
PATIENT_INFO (Patient_ID, Name, Patient_Address, Patient_PhoneNo, Email)
STAFF_INFO (Staff_ID, Name, PhoneNo, Address, Email)

RECEPTIONIST (Receptionist_ID, FrontDeskInterface, PatientRegistration, QueueManagement)

MEDICAL_REPORT

Report_ID (PK)	Patient_ID	Doctor_ID	PatientInfo

UTMRECORD

Record_ID (PK)	Patient_ID	Doctor_ID	LabResults	ExamRecords

APPOINTMENT

Appointment_ID (PK)	Doctor_ID	Patient_ID	Date	Time	Status

PATIENT

Patient_ID (PK)	MedicalHistory	AllergyHistory

EMAILNOTIFICATION

Notification_ID (PK)	Patient_ID	Doctor_ID	Date	Time	Status

PATIENT_INFO

Patient_ID (PK)	Name	Patient_Address	Patient_PhoneNo	Email

STAFF_INFO

Staff_ID (PK)	Name	PhoneNo	Address	Email

RECEPTIONIST

Receptionist_ID (PK)	FrontDeskInterface	PatientRegistration	QueueManagement

DOCTOR

Doctor_ID (PK)	Staff_ID	Specialty

SQL Statements

```
CREATE TABLE Patient (
   Patient_ID VARCHAR2(10) NOT NULL PRIMARY KEY,
   Medical_History VARCHAR2(50),
   Allergy_History VARCHAR2(50)
);

CREATE TABLE Patient_Info (
   Patient_ID VARCHAR2(10) NOT NULL,
   Patient_Name VARCHAR2(50) NOT NULL,
   Patient_address VARCHAR2(50) NOT NULL,
   CONSTRAINT Patient_ID_FK FOREIGN KEY (Patient_ID) REFERENCES Patient
(Patient_ID)
);

CREATE TABLE Staff_Info (
   Staff_ID VARCHAR2(10) NOT NULL PRIMARY KEY,
   Staff_Name VARCHAR2(50) NOT NULL,
   Staff_PhoneNo NUMBER(15) NOT NULL,
   Staff_Address VARCHAR2(50) NOT NULL,
   Staff_Email VARCHAR2(20) NOT NULL
);

CREATE TABLE Doctor (
   Doctor_ID VARCHAR2(10) NOT NULL PRIMARY KEY,
   Staff_ID VARCHAR2(10) NOT NULL,
   Speciality VARCHAR2(10) NOT NULL,
   CONSTRAINT Staff_ID_FK FOREIGN KEY (Staff_ID) REFERENCES Staff_Info
(Staff_ID)
);


CREATE TABLE MEDICAL_REPORT (
   Report_ID VARCHAR2(10) NOT NULL PRIMARY KEY,
   Patient_ID VARCHAR2(10) NOT NULL,
   Doctor_ID VARCHAR2(10) NOT NULL,
   PatientInfo VARCHAR2(30),
   CONSTRAINT Patient_ID_FK_2 FOREIGN KEY (Patient_ID) REFERENCES Patient
(Patient_ID),
   CONSTRAINT Doctor_ID_FK_2 FOREIGN KEY (Doctor_ID) REFERENCES Doctor
(Doctor_ID)
);



CREATE TABLE UTMRecords (
   Record_ID VARCHAR2(10) NOT NULL PRIMARY KEY,
```

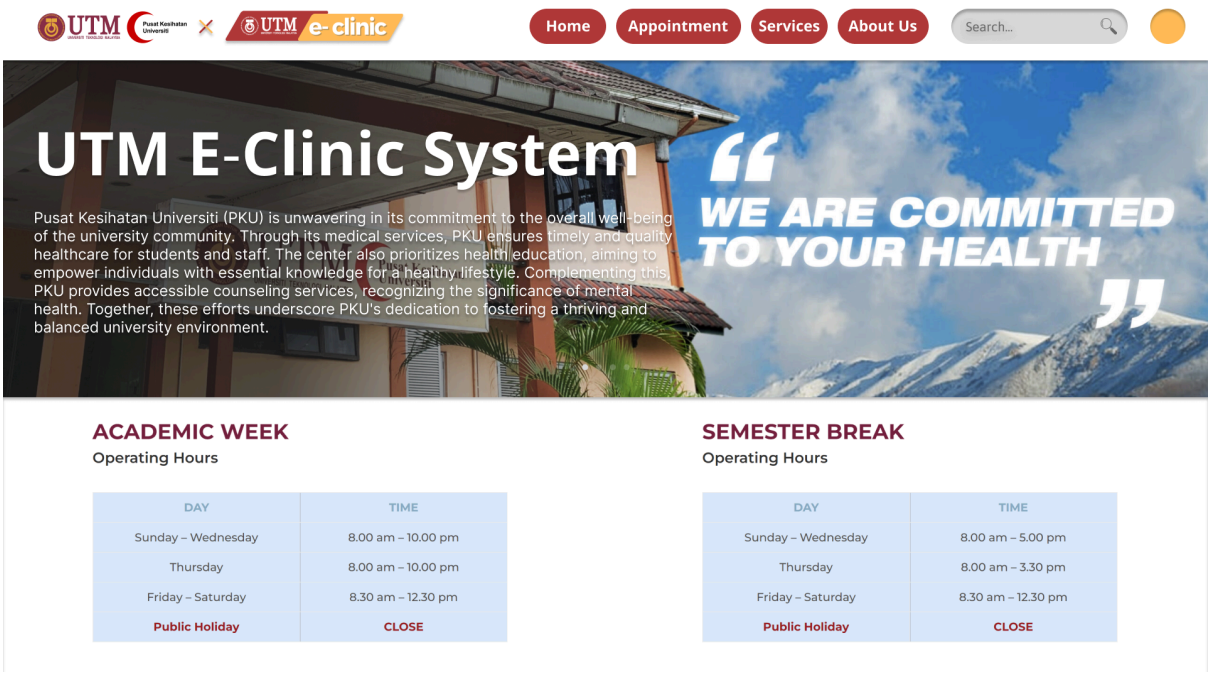
```
    Patient_ID VARCHAR2(10) NOT NULL,
    Doctor_ID VARCHAR2(10) NOT NULL,
    LabResults VARCHAR2(50),
    ConsultationRecord VARCHAR(50),
    CONSTRAINT Patient_ID_FK_3 FOREIGN KEY (Patient_ID) REFERENCES Patient
(Patient_ID),
    CONSTRAINT Doctor_ID_FK_3 FOREIGN KEY (Doctor_ID) REFERENCES Doctor
(Doctor_ID)
);

CREATE TABLE Appoinment (
    Appointment_ID VARCHAR2(10) NOT NULL PRIMARY KEY,
    Patient_ID VARCHAR2(10) NOT NULL,
    Doctor_ID VARCHAR2(10) NOT NULL,
    Appointment_Date DATE NOT NULL,
    Appointment_Time TIMESTAMP NOT NULL,
    Appointment_Status VARCHAR2(15) NOT NULL,
    CONSTRAINT Patient_ID_FK_4 FOREIGN KEY (Patient_ID) REFERENCES Patient
(Patient_ID),
    CONSTRAINT Doctor_ID_FK_4 FOREIGN KEY (Doctor_ID) REFERENCES Doctor
(Doctor_ID)
);

CREATE TABLE EmailNotification (
    Notification VARCHAR2(10) NOT NULL PRIMARY KEY,
    Patient_ID VARCHAR2(10) NOT NULL,
    Doctor_ID VARCHAR2(10) NOT NULL,
    EmailNotification_Date DATE NOT NULL,
    EmailNotification_Time TIMESTAMP NOT NULL,
    EmailNotification_Status VARCHAR2(15) NOT NULL,
    CONSTRAINT Patient_ID_FK_5 FOREIGN KEY (Patient_ID) REFERENCES Patient
(Patient_ID),
    CONSTRAINT Doctor_ID_FK_5 FOREIGN KEY (Doctor_ID) REFERENCES Doctor
(Doctor_ID)
);

CREATE TABLE Receptionist (
    Receptionist_ID VARCHAR2(10) NOT NULL PRIMARY KEY,
    Staff_ID VARCHAR2(10) NOT NULL,
    PatientRegistration VARCHAR2(10) NOT NULL,
    QueueManagement VARCHAR2(10) NOT NULL,
    CONSTRAINT Staff_ID_FK_5 FOREIGN KEY (Staff_ID) REFERENCES Staff_Info
(Staff_ID)
);


-- Patient table
INSERT INTO Patient (Patient_ID, Medical_History, Allergy_History)
```

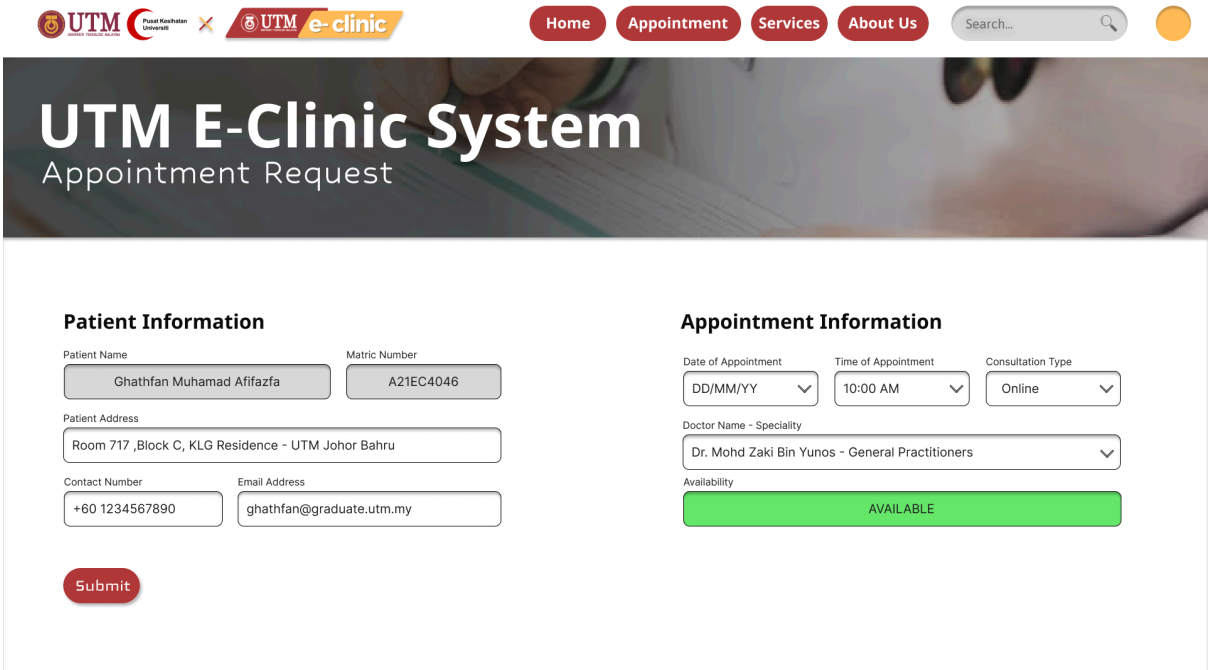
```
VALUES ('P001', 'Flu', 'Penicillin allergy');

INSERT INTO Patient (Patient_ID, Medical_History, Allergy_History)
VALUES ('P002', 'Vertigo', 'None');

INSERT INTO Patient (Patient_ID, Medical_History, Allergy_History)
VALUES ('P003', 'Fever', 'Sulfa allergy');

-- Patient_Info table
INSERT INTO Patient_Info (Patient_ID, Patient_Name, Patient_address)
VALUES ('P001', 'Zufar Einstein', 'KTR');

INSERT INTO Patient_Info (Patient_ID, Patient_Name, Patient_address)
VALUES ('P002', 'Phillip Xander', 'KLG Residence');

INSERT INTO Patient_Info (Patient_ID, Patient_Name, Patient_address)
VALUES ('P003', 'Muhammad Amirul', 'KDOJ');

-- Staff_Info table
INSERT INTO Staff_Info (Staff_ID, Staff_Name, Staff_PhoneNo, Staff_Address, Staff_Email)
VALUES ('S001', 'Dr. Anderson', 1234567890, 'Mutiara Rini', 'anderson@example.com');

INSERT INTO Staff_Info (Staff_ID, Staff_Name, Staff_PhoneNo, Staff_Address, Staff_Email)
VALUES ('S002', 'Dr. Davis', 0876543210, 'Taman Universiti', 'davis@example.com');

INSERT INTO Staff_Info (Staff_ID, Staff_Name, Staff_PhoneNo, Staff_Address, Staff_Email)
VALUES ('S003', 'Dr. Johnson', 5551112222, 'KLG Residence', 'johnson@example.com');

-- Doctor table
INSERT INTO Doctor (Doctor_ID, Staff_ID, Speciality)
VALUES ('D001', 'S001', 'General Practitioner');

INSERT INTO Doctor (Doctor_ID, Staff_ID, Speciality)
VALUES ('D002', 'S002', 'General Practitioner');

INSERT INTO Doctor (Doctor_ID, Staff_ID, Speciality)
VALUES ('D003', 'S003', 'General Practitioner');

-- MEDICAL_REPORT table
INSERT INTO MEDICAL_REPORT (Report_ID, Patient_ID, Doctor_ID, PatientInfo)
VALUES ('R001', 'P001', 'D001','Medical checkup');

INSERT INTO MEDICAL_REPORT (Report_ID, Patient_ID, Doctor_ID, PatientInfo)
VALUES ('R002', 'P002', 'D002', 'Medical checkup');

INSERT INTO MEDICAL_REPORT (Report_ID, Patient_ID, Doctor_ID, PatientInfo)
VALUES ('R003', 'P003', 'D003', 'Medical checkup');
```

```
-- UTMRecords table
INSERT INTO UTMRecords (Record_ID, Patient_ID, Doctor_ID, LabResults,
ConsultationRecord)
VALUES ('U001', 'P001', 'D001', 'N/A', 'Regular checkup');

INSERT INTO UTMRecords (Record_ID, Patient_ID, Doctor_ID, LabResults,
ConsultationRecord)
VALUES ('U002', 'P002', 'D002', 'Low Blood Pressure', 'Regular checkup');

INSERT INTO UTMRecords (Record_ID, Patient_ID, Doctor_ID, LabResults,
ConsultationRecord)
VALUES ('U003', 'P003', 'D003', 'N/A', 'Regular checkup');

-- Appoinment table
INSERT INTO Appoinment (Appointment_ID, Patient_ID, Doctor_ID, Appointment_Date,
Appointment_Time, Appointment_Status)
VALUES ('A001', 'P001', 'D001', TO_DATE('2024-01-15', 'YYYY-MM-DD'),
TO_TIMESTAMP('2024-01-15 10:00:00', 'YYYY-MM-DD HH24:MI:SS'), 'Scheduled');

INSERT INTO Appoinment (Appointment_ID, Patient_ID, Doctor_ID, Appointment_Date,
Appointment_Time, Appointment_Status)
VALUES ('A002', 'P002', 'D002', TO_DATE('2024-01-16', 'YYYY-MM-DD'),
TO_TIMESTAMP('2024-01-16 11:30:00', 'YYYY-MM-DD HH24:MI:SS'), 'Completed');

INSERT INTO Appoinment (Appointment_ID, Patient_ID, Doctor_ID, Appointment_Date,
Appointment_Time, Appointment_Status)
VALUES ('A003', 'P003', 'D003', TO_DATE('2024-01-17', 'YYYY-MM-DD'),
TO_TIMESTAMP('2024-01-17 14:45:00', 'YYYY-MM-DD HH24:MI:SS'), 'Canceled');

-- EmailNotification table
INSERT INTO EmailNotification (Notification, Patient_ID, Doctor_ID, EmailNotification_Date,
EmailNotification_Time, EmailNotification_Status)
VALUES ('N001', 'P001', 'D001', TO_DATE('2024-01-15', 'YYYY-MM-DD'),
TO_TIMESTAMP('2024-01-15 09:30:00', 'YYYY-MM-DD HH24:MI:SS'), 'Sent');

INSERT INTO EmailNotification (Notification, Patient_ID, Doctor_ID, EmailNotification_Date,
EmailNotification_Time, EmailNotification_Status)
VALUES ('N002', 'P002', 'D002', TO_DATE('2024-01-16', 'YYYY-MM-DD'),
TO_TIMESTAMP('2024-01-16 12:15:00', 'YYYY-MM-DD HH24:MI:SS'), 'Delivered');

INSERT INTO EmailNotification (Notification, Patient_ID, Doctor_ID, EmailNotification_Date,
EmailNotification_Time, EmailNotification_Status)
VALUES ('N003', 'P003', 'D003', TO_DATE('2024-01-17', 'YYYY-MM-DD'),
TO_TIMESTAMP('2024-01-17 15:00:00', 'YYYY-MM-DD HH24:MI:SS'), 'Failed');

select
   "PATIENT_ID",
   "MEDICAL_HISTORY",
```

```
    "ALLERGY_HISTORY"
from "PATIENT";

select
    "APPOINTMENT_ID",
    "PATIENT_ID",
    "DOCTOR_ID",
    "APPOINTMENT_DATE",
    "APPOINTMENT_TIME",
    "APPOINTMENT_STATUS"
from "APPOINMENT";

select
    "NOTIFICATION",
    "PATIENT_ID",
    "DOCTOR_ID",
    "EMAILNOTIFICATION_DATE",
    "EMAILNOTIFICATION_TIME",
    "EMAILNOTIFICATION_STATUS"
from "EMAILNOTIFICATION";

select * from Doctor where Doctor_ID LIKE '%D002%';

SELECT *
FROM UTMRECORDS
INNER JOIN APPOINMENT ON UTMRECORDS.DOCTOR_ID =
APPOINMENT.DOCTOR_ID
where UTMRECORDS.Doctor_ID LIKE '%D002%'
```

User Interface Design





Summary

This document outlines the design of the logical ERD of the system and the normalization process. The Data Dictionary is also modified to conform to the new logical ERD as well as the Relational Database schema. These changes were implemented in the SQL statements by applying both DDL and DML.