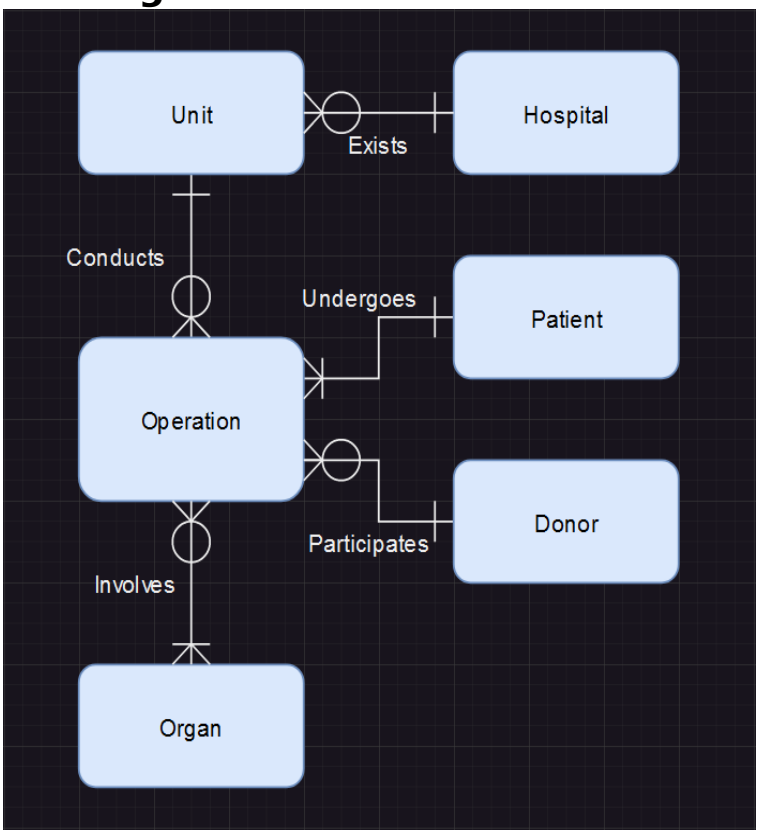
Student Roll #	@00677611
User ID	CHC119
Assessment Title	DBS Semester One Coursework
Module Title	Database Systems
CRN	32741

ER Diagram:



Logical Model:

Entities:
hospital(hospital_id, hospital_name, city, postcode)
transplant_unit(unit_id, hospital_id*, specialisation)
organ(organ_id, organ_type)
donor(donor_id, donor_name, age)
patient(nhs_id, paitent_name, age)
operation(operation_id, organ_id*, unit_id*, nhs_id*, donor_id*)

One-to-Many Relationship:

- One hospital can have 0, 1 or many transplant units. A unit must have a hospital. (**Hospital – Transplant Unit [1:M][m:o]**)
- One unit can conduct 0, 1 or many operations. An operation must have a unit. (**Unit – Operation [1:M][o:m]**)
- One patient must undergo 1 or multiple operations. An operation must have a patient. (**Patient – Operation [1:M][m:m]**)
- One donor can participate in 0, 1 or many operations. An operation must have a donor (**Donor – Operation [1:M][m:o]**)

Many-to-Many Relationship:

- Many operations can involve multiple organ types. An operation must have an organ, but an organ may not be used. (**Operation – Organ [M:M][o:m]**)

Explanation of Normalisation:

1st Normal Form (**1NF**):

- Atomic Values
  - Every table has columns exclusively containing indivisible values.
  - There are no repeating groups or arrays within columns.

2nd Normal Form (**2NF**):

- Already in 1NF.
- No Partial Dependencies
  - Each non-key attribute is fully functionally dependent on the entire primary key.
  - In the hospital, transplant_unit, organ, donor, and patient tables, attributes are fully dependent on their respective primary keys (hospital_id, unit_id, organ_id, donor_id, patient_id).

3rd Normal Form (**3NF**):

- Already 2NF
- No Transitive Dependencies
  - There are no transitive dependencies between non-candidate attributes.
  - In the hospital table, city and postcode are functionally dependent on hospital_id (primary key). No transitive dependency exists between these attributes.

Statements for creating the Database relations:

(Kept to ISO standard as much as possible by using postgreSQL – foreign key constraints moved from inline)

```
CREATE TABLE hospital (
        hospital_id CHAR(3) CONSTRAINT hID_pk PRIMARY KEY,
        hospital_name VARCHAR(30) CONSTRAINT hospital_name_not_null NOT NULL,
        city VARCHAR(15),
        postcode VARCHAR(8) CONSTRAINT postcode_unique UNIQUE
);
CREATE TABLE transplant_unit (
        unit_id CHAR(4) CONSTRAINT uID_pk PRIMARY KEY,
        hospital_id CHAR(3),
        specialisation VARCHAR(20),
        CONSTRAINT hID_fk FOREIGN KEY ( hospital_id ) REFERENCES hospital( hospital_id )
);
CREATE TABLE organ (
        organ_id CHAR(3) CONSTRAINT oID_pk PRIMARY KEY,
        organ_type VARCHAR(15)
);
CREATE TABLE patient (
        nhs_id CHAR(3) CONSTRAINT pID_pk PRIMARY KEY,
        patient_name VARCHAR(10) CONSTRAINT patient_name_not_null NOT NULL,
        age INTEGER
);
CREATE TABLE donor (
        donor_id CHAR(3) CONSTRAINT dID_pk PRIMARY KEY,
        donor_name VARCHAR(10) CONSTRAINT donor_name_not_null NOT NULL,
        age INTEGER
);
CREATE TABLE operation (
        operation_id CHAR(3),
        organ_id CHAR(3),
```

```
	unit_id CHAR(4),
	nhs_id CHAR(3),
	donor_id CHAR(3),
	CONSTRAINT comp_op_key PRIMARY KEY ( operation_id, organ_id ),
	CONSTRAINT oID_fk FOREIGN KEY ( organ_id ) REFERENCES organ( organ_id ),
	CONSTRAINT uID_fk FOREIGN KEY ( unit_id ) REFERENCES transplant_unit( unit_id ),
	CONSTRAINT pID_fk FOREIGN KEY ( nhs_id ) REFERENCES patient( nhs_id ),
	CONSTRAINT dID_fk FOREIGN KEY ( donor_id ) REFERENCES donor( donor_id )
);
```

Statements for populating the Database:

```
INSERT INTO hospital
VALUES	('h01', 'Royal Infirmary', 'Manchester', 'M13 1AB'),
		('h02', 'St James University Hospital', 'Leeds', 'LE6 6JX'),
		('h03', 'Eye hospital', 'Manchester', 'M5 3AC'),
		('h04', 'Wythenshawe Hospital', 'Manchester', 'M22 4XD');
INSERT INTO transplant_unit
VALUES	( 'u001', 'h01', 'Kidney (Renal)' ),
		( 'u002', 'h02', 'Kidney (Renal)' ),
		( 'u003', 'h01', 'Pancreas' ),
		( 'u004', 'h02', 'Liver' ),
		( 'u005', 'h04', 'Cardiothoracic' );
INSERT INTO organ
VALUES	( 'o1', 'kidney' ),
		( 'o2', 'heart' ),
		( 'o3', 'lung' ),
		( 'o4', 'pancreas' ),
		( 'o5', 'liver' );
INSERT INTO patient
VALUES	( 'p03', 'ben', 58 ),
		( 'p04', 'jane', 27),
		( 'p05', 'joan', 50);
INSERT INTO donor
VALUES	( 'd01', 'tom', 34 ),
		( 'd02', 'dick', 45 ),
		( 'd03', 'harry', 27 ),
		( 'd04', 'sue', 60 ),
		( 'd05', 'kate', 49 ),
		( 'd06', 'rose', 34 );
INSERT INTO operation
VALUES	( 'op1', 'o1', 'u002', 'p03', 'd01' ),
		( 'op2', 'o2', 'u005', 'p04', 'd02' ),
		( 'op2', 'o3', 'u005', 'p04', 'd02' ),
		( 'op3', 'o4', 'u003', 'p05', 'd03' ),
		( 'op4', 'o5', 'u004', 'p05', 'd05' ),
		( 'op5', 'o5', 'u002', 'p03', 'd01' );
```

Statements for querying the Database:

```
SELECT patient_name
FROM patient
WHERE age >= 50
ORDER BY patient_name;
```

```
SELECT organ_type, COUNT( organ_type )
FROM organ
INNER JOIN operation ON operation.organ_id = organ.organ_id
GROUP BY organ_type;

SELECT hospital_id, COUNT( hospital_id )
FROM transplant_unit
INNER JOIN operation ON transplant_unit.unit_id = operation.unit_id
GROUP BY hospital_id;

SELECT MAX( age ) AS oldest_donor
FROM donor
WHERE donor_id IN (
	SELECT donor_id
	FROM operation
	WHERE unit_id IN (
		SELECT unit_id
		FROM transplant_unit
		WHERE hospital_id IN (
			SELECT hospital_id
			FROM hospital
			WHERE city LIKE '%Manchester%'
		)
	)
);
```