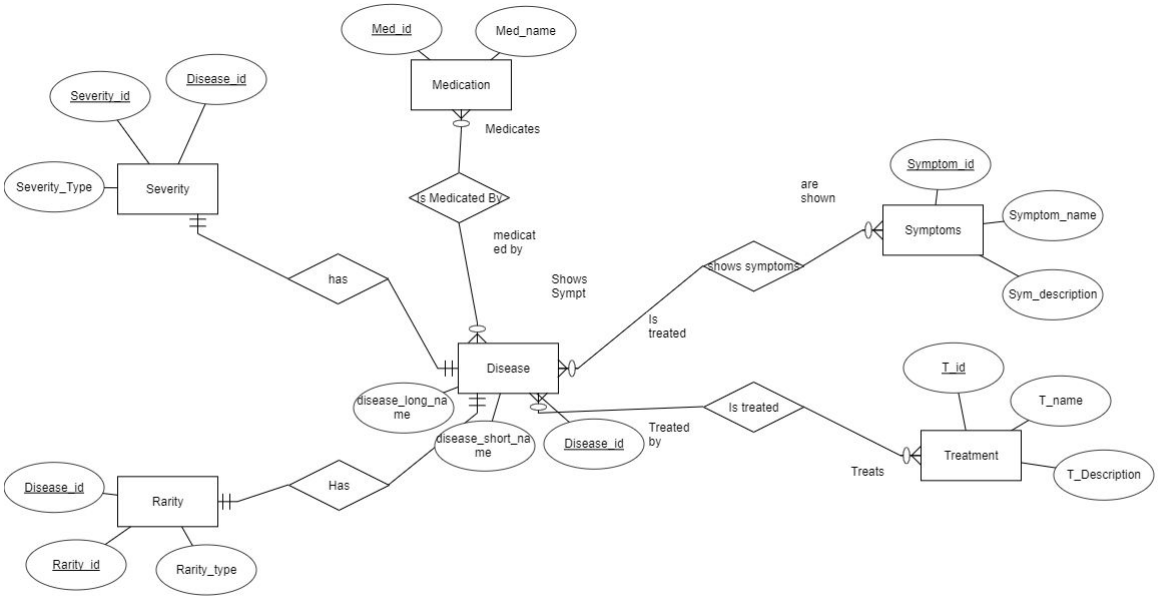
CS3041 Database Design Claire Gribbin 16325614

I decided to model a Disease Database, where I store Diseases, their treatment, and their individual severity, and rarity.

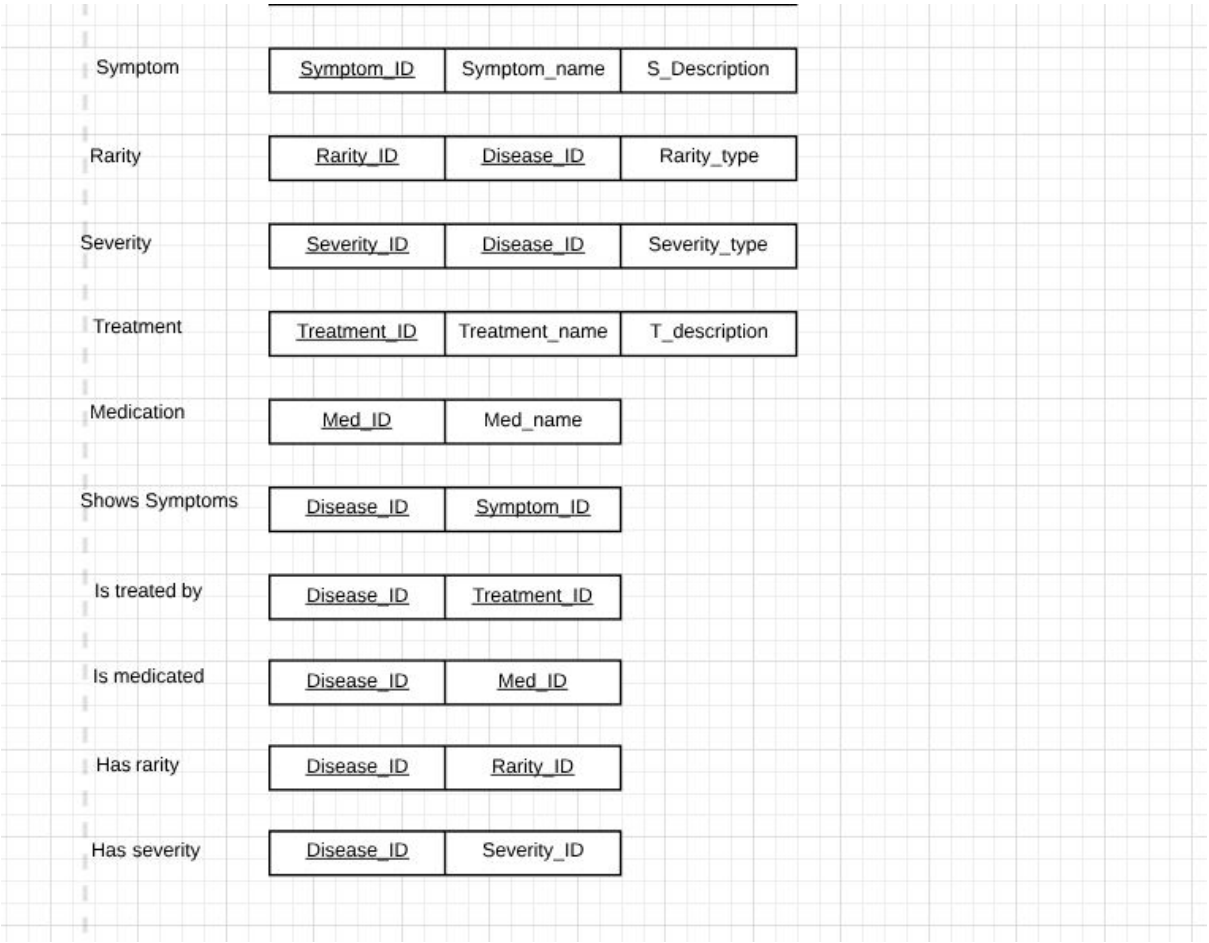


I chose to model a relationship for each because of how a disease is defined, it ‘has’ a severity and a rarity, ‘shows’ symptoms and ‘is treated’ by treatment and medication.

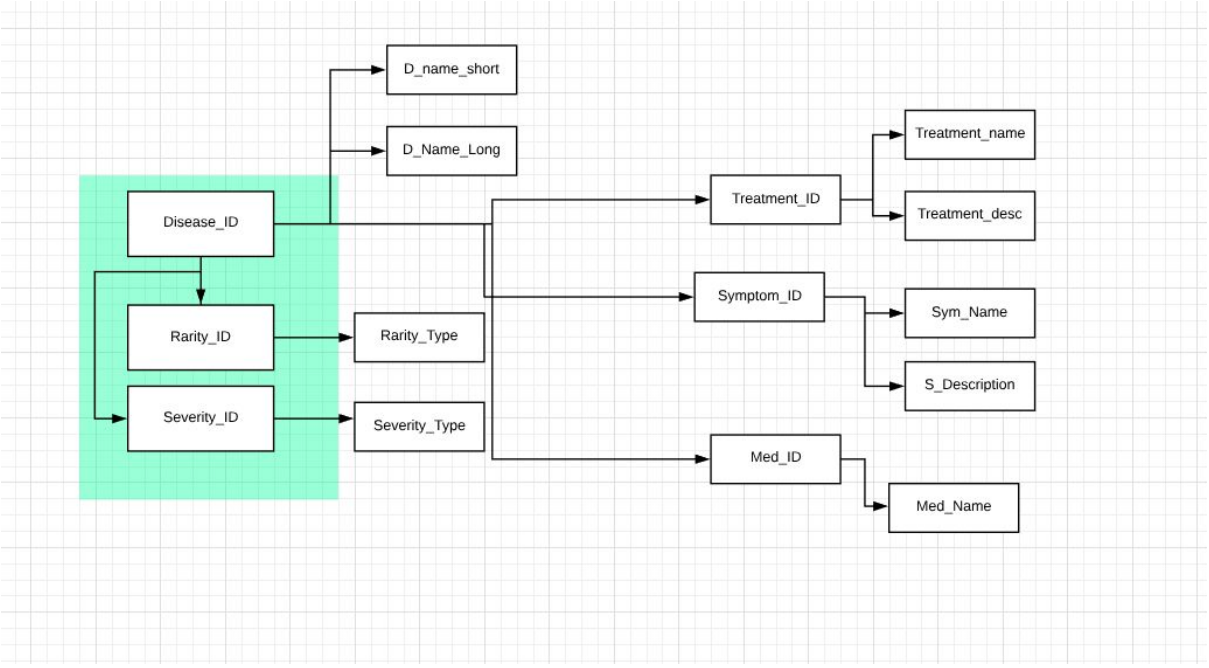
There is a 1-1 relationship between the disease and its rarity and severity, because a disease has a single value for how rare it is, and how severe it is, these do not change and must be included in the database.
There is a many to many relationship between Disease and Symptoms, Disease and Medication, and Disease and treatment. These relationships are modelled using a relationship table where the ID of the disease is listed with the ID of the Symptoms/Treatments/Medications
.

They are all optional, as not every disease has symptoms, and not every disease can be treated.

Relational Schema



Functional Dependency Diagram



Normalised Relations:

Disease(disease_id,disease_name_short,disease_name_long)
Symptoms(symptom_id, symptom_name, symptom_description)
Rarity(rarity_id, disease_id, rarity_type)
Severity(severity_id, disease_id, severity_type)
Treatment(t_id, t_name, t_description)
Medication(med_id, med_name)

Primary keys:
Shown by black underline.
Foreign keys:
Shown by red underline.

Integrity Constraints:
NOT NULL - for primary keys, must also be unique.
NOT NULL - for foreign keys, must also be unique.
NOT NULL - for disease_name_long, disease_name_short, and symptom_name

DELETE ON CASCADE - for foreign key relationships, to delete corresponding records in the child table, when data in the parent table is deleted.

Table Constraints:
Severity and Rarity must be related to a disease in order to exist. So that no severity value exists without being associated with a disease.
Enums: In severity and rarity, the value associated with each entry can only be of certain types.

Disease :

The Disease Table stores a Disease ID which is a unique ID, a short (abbreviated) version of the disease name, and the disease's full name.
The Disease ID is a primary key, which means that it cannot be a NULL value and it must be unique.

The short name for a disease is not unique, as many diseases share abbreviations. The long name would normally be unique but to avoid extremely rare cases, I did not make it unique, each disease can be told apart based on its ID.

```
CREATE TABLE Disease (
        disease_id int(11) NOT NULL,
        disease_name_short varchar(30) NOT NULL,
        disease_name_long varchar(300) NOT NULL,
        PRIMARY KEY (`disease_id`)
)
```

Rarity:

The Rarity table stores how rare each disease is.
It stores a disease_ID, a rarity_ID and a rarity type. The disease_ID is a foreign key, used to reference the disease on which I am storing the rarity of. It is a unique value, and cannot be NULL.
The rarity_ID is a primary key, which references the specific instance of rarity. It must be unique and not null.
The rarity type is restricted to ‘common’,’rare’, and ‘ultra rare’. This should not be null but it is possible that this data is not available, so I left NULL as an option.

```
CREATE TABLE Rarity (
        disease_id int(11) NOT NULL,
        rarity_id int(11) NOT NULL,
        rarity_type enum('common','rare','ultra_rare') DEFAULT NULL,
        PRIMARY KEY (rarity_id),
        FOREIGN KEY disease_id (disease_id),
        CONSTRAINT rarity_ibfk_1 FOREIGN KEY (`disease_id`) REFERENCES
        disease(`disease_id`) ON DELETE CASCADE ON UPDATE CASCADE
)
```

Severity:

The Severity table stores how severe each disease is.
It stores a disease_ID, a severity_ID and a severity type. The disease_ID is a foreign key, used to reference the disease on which I am storing the rarity of. It is a unique value, and cannot be NULL.
The severity_ID is a primary key, which references the specific instance of severity. It must be unique and not null.
The severity type is restricted to ‘mild’,’moderate’, and ‘severe’. This should not be null but it is possible that this data is not available, so I left NULL as an option.

```
CREATE TABLE `severity` (
  `disease_id` int(11) NOT NULL,
  `severity_id` int(11) NOT NULL,
  `severity_type` enum('mild','moderate','severe') DEFAULT NULL,
  PRIMARY KEY (`severity_id`),
  KEY `disease_id` (`disease_id`),
  CONSTRAINT `severity_ibfk_1` FOREIGN KEY (`disease_id`) REFERENCES `disease`
(`disease_id`) ON DELETE CASCADE ON UPDATE CASCADE
)
```

Symptoms:

In the symptom table, there is a symptom_id, a symptom_name, and a symptom_description. The ID is a primary key, which must be NOT NULL, and unique.

There are only restrictions on the size of the name and description, as symptoms vary widely.
I will be using a joining table to associate symptoms with diseases as it is a many to many relation, diseases can have many symptoms, and symptoms can be associated with many diseases.

```
CREATE TABLE `symptoms` (
  `symptom_id` int(11) NOT NULL,
  `symptom_name` varchar(200) NOT NULL,
  `symptom_desc` varchar(300) DEFAULT NULL,
  PRIMARY KEY (`symptom_id`)
)
```

Treatment:

In the treatment table, there is a treatment_id, a treatment_name, and a treatment_description. The ID is a primary key, which must be NOT NULL, and unique.
There are only restrictions on the size of the name and description, as treatments are generally quite different based on the disease.
I will be using a joining table to associate treatments with diseases as it is a many to many relation, diseases can have many treatments as some may not work, and treatments can be the same for different diseases.

```
CREATE TABLE `treatment` (
  `t_id` int(11) NOT NULL,
  `t_name` varchar(100) NOT NULL,
  `t_desc` varchar(300) DEFAULT NULL,
  PRIMARY KEY (`t_id`)
)
```

Medication:

In the medication table there is a med_id and a med_name.
The med_id is a primary key which must be unique and NOT NULL. The name can be anything but has a size restriction.
I will be using a joining table to associate medication with diseases as it is a many to many relationship as diseases can be treated with a variety of medication and medication is not unique to a disease in most cases.

```
CREATE TABLE `meds` (
  `med_id` int(11) NOT NULL,
  `med_name` varchar(150) NOT NULL,
  PRIMARY KEY (`med_id`)
)
```

Joining Tables:

For the many to many relationships I used a joining table to connect a disease with its symptoms, treatment and medication.

ON DELETE CASCADE - Will delete child table data when parent table data is deleted.

```
CREATE TABLE `disease_symptoms` (
  `disease_id` int(11) NOT NULL,
  `symptom_id` int(11) NOT NULL,
  UNIQUE KEY `disease_id` (`disease_id`,`symptom_id`),
  KEY `symptom_id` (`symptom_id`),
  CONSTRAINT `disease_symptoms_ibfk_1` FOREIGN KEY (`disease_id`) REFERENCES
`disease` (`disease_id`)ON DELETE CASCADE,
  CONSTRAINT `disease_symptoms_ibfk_2` FOREIGN KEY (`symptom_id`) REFERENCES
`symptoms` (`symptom_id`) ON DELETE CASCADE
)
```

```
CREATE TABLE `disease_treatment` (
  `t_id` int(11) NOT NULL,
  `disease_id` int(11) NOT NULL,
  UNIQUE KEY `disease_id` (`disease_id`,`t_id`),
  KEY `t_id` (`t_id`),
  CONSTRAINT `disease_treatment_ibfk_1` FOREIGN KEY (`disease_id`) REFERENCES
`disease` (`disease_id`) ON DELETE CASCADE,
  CONSTRAINT `disease_treatment_ibfk_2` FOREIGN KEY (`t_id`) REFERENCES
`treatment` (`t_id`) ON DELETE CASCADE
)
```

```
CREATE TABLE `disease_meds` (
  `med_id` int(11) NOT NULL,
  `disease_id` int(11) NOT NULL,
  UNIQUE KEY `med_id` (`med_id`,`disease_id`),
  KEY `disease_id` (`disease_id`),
  CONSTRAINT `disease_meds_ibfk_1` FOREIGN KEY (`med_id`) REFERENCES `meds`
(`med_id`) ON DELETE CASCADE,
  CONSTRAINT `disease_meds_ibfk_2` FOREIGN KEY (`disease_id`) REFERENCES
`disease` (`disease_id`) ON DELETE CASCADE
)
```

Security Choice:

Database views allow users to access the data without being able to access the tables themselves. Essentially, a view uses the results of a database query to populate the contents of an artificial database ‘table’. A user can dump the view, without destroying the data underneath it. I used this to create very simple views for all of the tables.
For rarity and severity, I used a table join view to associate the disease name with the values to make it easier to read.

DISEASE VIEW

```
CREATE VIEW `ddb`.`show_disease` AS
   SELECT
      `ddb`.`disease`.`disease_id` AS `disease_id`,
      `ddb`.`disease`.`disease_name_short` AS `disease_name_short`,
      `ddb`.`disease`.`disease_name_long` AS `disease_name_long`
   FROM
      `ddb`.`disease
```

SYMPTOM VIEW

```
CREATE
   ALGORITHM = UNDEFINED
   DEFINER = `root`@`localhost`
   SQL SECURITY DEFINER
VIEW `ddb`.`symptom_view` AS
   SELECT
      `ddb`.`symptoms`.`symptom_id` AS `symptom_id`,
      `ddb`.`symptoms`.`symptom_name` AS `symptom_name`,
      `ddb`.`symptoms`.`symptom_desc` AS `symptom_desc`
   FROM
      `ddb`.`symptoms`
```

SYMPTOM_DISEASE VIEW
Shows disease names for each symptom name.
Makes viewing data easier, no ID checking required.

```
CREATE
   ALGORITHM = UNDEFINED
   DEFINER = `root`@`localhost`
   SQL SECURITY DEFINER
VIEW `ddb`.`symptomsforeach` AS
   SELECT
      `d`.`disease_name_long` AS `disease_name_long`,
      `s`.`symptom_name` AS `symptom_name`,
      `d`.`disease_id` AS `dis_id1`,
```

```
    `ds`.`symptom_id` AS `symptom_id`,
    `ds`.`disease_id` AS `dis_id2`
  FROM
    ((`ddb`.`disease` `d`
    JOIN `ddb`.`disease_symptoms` `ds`)
    JOIN `ddb`.`symptoms` `s`)
  WHERE
    ((`d`.`disease_id` = `ds`.`disease_id`)
      AND (`s`.`symptom_id` = `ds`.`symptom_id`))
```

Rarity View

```
CREATE
  ALGORITHM = UNDEFINED
  DEFINER = `root`@`localhost`
  SQL SECURITY DEFINER
VIEW `ddb`.`rarity_diseases` AS
  SELECT
    `d`.`disease_name_long` AS `disease_name_long`,
    `r`.`rarity_type` AS `rarity_type`
  FROM
    (`ddb`.`disease` `d`
    JOIN `ddb`.`rarity` `r` ON ((`r`.`rarity_id` = `d`.`disease_id`)))
```

Severity View

```
CREATE
  ALGORITHM = UNDEFINED
  DEFINER = `root`@`localhost`
  SQL SECURITY DEFINER
VIEW `ddb`.`severity_diseases` AS
  SELECT
    `d`.`disease_name_long` AS `disease_name_long`,
    `s`.`severity_type` AS `severity_type`
  FROM
    (`ddb`.`disease` `d`
    JOIN `ddb`.`severity` `s` ON ((`s`.`severity_id` = `d`.`disease_id`)))
```

Treatment_Disease view:

Like symptom disease view, makes it easier to read as it associates the disease name with the treatment.

```
CREATE
  ALGORITHM = UNDEFINED
  DEFINER = `root`@`localhost`
  SQL SECURITY DEFINER
VIEW `ddb`.`disease_treatments` AS
  SELECT
    `d`.`disease_name_long` AS `disease_name_long`,
```

```
    `t`.`t_name` AS `treatment_name`,
    `d`.`disease_id` AS `d_id1`,
    `dt`.`disease_id` AS `d_id2`,
    `dt`.`t_id` AS `t_id`
  FROM
    ((`ddb`.`disease` `d`
    JOIN `ddb`.`disease_treatment` `dt`)
    JOIN `ddb`.`treatment` `t`)
  WHERE
    ((`d`.`disease_id` = `dt`.`disease_id`)
      AND (`t`.`t_id` = `dt`.`t_id`))
```

Disease Medication view:
Same idea as disease_treatments view

```
CREATE
  ALGORITHM = UNDEFINED
  DEFINER = `root`@`localhost`
  SQL SECURITY DEFINER
VIEW `ddb`.`disease_medication` AS
  SELECT
    `d`.`disease_name_long` AS `disease_name`,
    `d`.`disease_id` AS `d_id1`,
    `dm`.`disease_id` AS `d_id2`,
    `dm`.`med_id` AS `med_id`,
    `m`.`med_name` AS `medication_name`
  FROM
    ((`ddb`.`disease` `d`
    JOIN `ddb`.`disease_meds` `dm`)
    JOIN `ddb`.`meds` `m`)
  WHERE
    ((`d`.`disease_id` = `dm`.`disease_id`)
      AND (`m`.`med_id` = `dm`.`med_id`))
```

TRIGGER:
Updates new Updates table when diseases is updates. Keeps track of alterations to the database. For root user to easily know each update and what disease it is.

```
CREATE DEFINER=`root`@`localhost` TRIGGER `disease_AFTER_INSERT` AFTER
INSERT ON `disease` FOR EACH ROW BEGIN
INSERT INTO updates(u1,u2) VALUES (new.disease_id, new.disease_name_long);
END
```

Queries:
UPDATES:
Let's say I want to update a symptom to add a description

Currently there is a row :
30, noise sensitivity, NULL
To add a description:
SQL> UPDATE Symptoms
SET symptom_desc = 'some frequencies may be unbearable and some noises may seem much louder than they are'
WHERE symptom_id = 30;
NEW DATA:
30, noise sensitivity, some frequencies may be unbearable, and some noises may seem much louder than they are
In treatment there is a row:
2 , occupational therapy , NULL
SQL> UPDATE Treatment
SET t_desc = 'the use of particular activities as an aid to recuperation from physical or mental illness.'
WHERE t_id = 2;
NEW DATA:
2 , occupational therapy , the use of particular activities as an aid to recuperation from physical or mental illness
INSERT:
Create a new disease + related data:
Disease:
Insert into Disease(disease_id, disease_name_short,disease_name_long)
values(6,'CF','Cystic Fibrosis');
Symptoms:
Insert into symptoms(symptom_id, symptom_name) values (31, 'persistent cough');
insert into symptoms values (32, 'respiratory issues','wheezing, breathlessness, exercise intolerance, repeated lung infections');
insert into symptoms(symptom_id, symptom_name) values (33, 'poor weight gain and growth');
insert into symptoms(symptom_id, symptom_name) values (34, 'severe constipation');
Rarity:
insert into rarity values(6,6,'rare');
Severity:
insert into severity values(6,6,'severe')
Treatment:
insert into treatment values(12, 'airway clearing techniques','these include: active deep breathing techniques, gentle controlled breathing techniques to clear muscus from the lungs ect.');
insert into treatment values(13, 'lung transplant','may be required when symptoms severe');
Meds:
insert into meds values(15, 'bronchodilators');
insert into meds values(16, 'mucus thinners');
insert into meds values(17, 'digestive enzymes');
Disease_treatment:
insert into disease_treatment values(12,6);

insert into disease_treatment values(13,6);

Disease_Symptoms:

insert into disease_symptoms values(6,31);
insert into disease_symptoms values(6,32);
insert into disease_symptoms values(6,33);
insert into disease_symptoms values(6,34);

Disease_meds:

insert into disease_meds values(15,6);
insert into disease_meds values(16,6);
insert into disease_meds values(17,6);

<u>All views update automatically:</u>

Disease symptoms views

disease_name_long	symptom_name	dis_id1	symptom_id	dis_id2
Acute Intermittent Porphyria	Severe Abdominal Pain	1	1	1
Acute Intermittent Porphyria	chest/leg/back pain	1	2	1
Acute Intermittent Porphyria	bowel problems	1	3	1
Acute Intermittent Porphyria	nausea/vomiting	1	4	1
Acute Intermittent Porphyria	mental changes	1	5	1
Acute Intermittent Porphyria	muscle issues	1	6	1
Acute Intermittent Porphyria	dark urine	1	7	1
Acute Intermittent Porphyria	breathing problems	1	8	1
Acute Intermittent Porphyria	urination problems	1	9	1
Acute Intermittent Porphyria	irregular heartbeat	1	10	1
Acute Intermittent Porphyria	high blood pressure	1	11	1
Acute Intermittent Porphyria	seizures	1	12	1
Classical Ehlers-Danlos Syndrome	skin abnormalities	2	13	2
Classical Ehlers-Danlos Syndrome	abnormal wound healing	2	14	2
Classical Ehlers-Danlos Syndrome	joint hypermobility	2	15	2
Classical Ehlers-Danlos Syndrome	molluscoid psuedotumors	2	16	2
Classical Ehlers-Danlos Syndrome	subcutaneos spheroids	2	17	2
Classical Ehlers-Danlos Syndrome	hypotonia	2	18	2
Classical Ehlers-Danlos Syndrome	delayed moter development	2	19	2
Classical Ehlers-Danlos Syndrome	fragile tissue	2	20	2
Classical Ehlers-Danlos Syndrome	cardiovascular abnormalities	2	21	2
Classical Ehlers-Danlos Syndrome	pregnancy complications	2	22	2
bacterial meningitis	nausea/vomiting	3	4	3
bacterial meningitis	headache	3	23	3
bacterial meningitis	stiff neck	3	24	3
bacterial meningitis	photophobia	3	25	3
bacterial meningitis	altered mental state	3	26	3
hyperkalemia	nausea/vomiting	4	4	4
hyperkalemia	muscle issues	4	6	4
hyperkalemia	dark urine	4	7	4
hyperkalemia	breathing problems	4	8	4
myalgic encephalomyeltis	chest/leg/back pain	5	2	5
myalgic encephalomyeltis	mental changes	5	5	5
myalgic encephalomyeltis	muscle issues	5	6	5
myalgic encephalomyeltis	irregular heartbeat	5	10	5
myalgic encephalomyeltis	headache	5	23	5
myalgic encephalomyeltis	photophobia	5	25	5
myalgic encephalomyeltis	altered mental state	5	26	5
myalgic encephalomyeltis	brain fog	5	27	5
myalgic encephalomyeltis	muscle/joint pain	5	28	5
myalgic encephalomyeltis	dizziness	5	29	5
myalgic encephalomyeltis	noise sensitivity	5	30	5
Cystic Fibrosis	persistent cough	6	31	6
Cystic Fibrosis	respiratory issues	6	32	6
Cystic Fibrosis	poor weight gain and growth	6	33	6
Cystic Fibrosis	severe constipation	6	34	6

Disease medication view

disease_name	d_id1	d_id2	med_id	medication_name
Acute Intermittent Porphyria	1	1	1	Hemin/Panhematin
Classical Ehlers-Danlos Syndrome	2	2	2	non steroidal anti inflammatory medication
bacterial meningitis	3	3	3	Antibiotics
hyperkalemia	4	4	4	insulin
hyperkalemia	4	4	5	sodium bicarbonate
hyperkalemia	4	4	6	beta agonists
hyperkalemia	4	4	7	diuretics
hyperkalemia	4	4	8	sodium polystyrene sulfonate
myalgic encephalomyeltis	5	5	9	adderal
myalgic encephalomyeltis	5	5	10	vyvanse
myalgic encephalomyeltis	5	5	11	ritalin
myalgic encephalomyeltis	5	5	13	antidepressants
myalgic encephalomyeltis	5	5	14	painkillers - OTC
Cystic Fibrosis	6	6	15	bronchodialaters
Cystic Fibrosis	6	6	16	mucus thinners
Cystic Fibrosis	6	6	17	digestive enzymes

Disease treatment view

```
MySQL  localhost:33060+ ssl  ddb  SQL > select * from disease_treatments;
+-------------------------------+-----------------------------------------+-------+-------+------+
| disease_name_long             | treatment_name                          | d_id1 | d_id2 | t_id |
+-------------------------------+-----------------------------------------+-------+-------+------+
| Acute Intermittent Porphyria  | diet                                    |     1 |     1 |    1 |
| Classical Ehlers-Danlos Syndrome | occupational therapy                 |     2 |     2 |    2 |
| Classical Ehlers-Danlos Syndrome | extra treatment required for wounds  |     2 |     2 |    3 |
| Classical Ehlers-Danlos Syndrome | non steroidal anti inflammatory medication |  2 |     2 |    4 |
| bacterial meningitis          | antibiotics                             |     3 |     3 |    5 |
| hyperkalemia                  | hemodialiysis                           |     4 |     4 |    6 |
| hyperkalemia                  | medication                              |     4 |     4 |    7 |
| myalgic encephalomyeltis      | medication                              |     5 |     5 |    7 |
| myalgic encephalomyeltis      | CBT                                     |     5 |     5 |    8 |
| myalgic encephalomyeltis      | GET                                     |     5 |     5 |    9 |
| myalgic encephalomyeltis      | activity management                     |     5 |     5 |   10 |
| myalgic encephalomyeltis      | equipment needs                         |     5 |     5 |   11 |
| Cystic Fibrosis               | airway clearing techniques              |     6 |     6 |   12 |
| Cystic Fibrosis               | lung transplant                         |     6 |     6 |   13 |
+-------------------------------+-----------------------------------------+-------+-------+------+
```

Disease rarity view

disease_name_long	rarity_type
Acute Intermittent Porphyria	ultra_rare
Classical Ehlers-Danlos Syndrome	rare
bacterial meningitis	rare
hyperkalemia	rare
myalgic encephalomyeltis	rare
Cystic Fibrosis	rare

Disease severity view

disease_name_long	severity_type
Acute Intermittent Porphyria	severe
Classical Ehlers-Danlos Syndrome	severe
bacterial meningitis	severe
hyperkalemia	moderate
myalgic encephalomyeltis	moderate
Cystic Fibrosis	severe

Disease view

disease_id	disease_name_short	disease_name_long
1	AIP	Acute Intermittent Porphyria
2	cEDS	Classical Ehlers-Danlos Syndrome
3	N/a	bacterial meningitis
4	elevated potassium	hyperkalemia
5	CFS/ME	myalgic encephalomyeltis
6	CF	Cystic Fibrosis

Symptom view

symptom_id	symptom_name	symptom_desc
1	Severe Abdominal Pain	severe pain in abdomin
2	chest/leg/back pain	NULL
3	bowel problems	constipation, diarrhea
4	nausea/vomiting	NULL
5	mental changes	anxiety, confusion, paranoia, disorientation, hallucinations
6	muscle issues	pain in muscles, tingling, weakness, numbness or paralysis are all symptoms
7	dark urine	NULL
8	breathing problems	NULL
9	urination problems	NULL
10	irregular heartbeat	heart palpitations, rapid heartrate
11	high blood pressure	NULL
12	seizures	NULL
13	skin abnormalities	smooth velevty skin that is highly elastic and bruises easily
14	abnormal wound healing	may result in wide atrophic scars (flat/depressed scars)
15	joint hypermobility	NULL
16	molluscoid psuedotumors	calcified hemotomas over pressure points such as the elbow
17	subcutaneos spheroids	fat containing cysts often found on the shins/forearms
18	hypotonia	poor muscle tone at birth
19	delayed moter development	NULL
20	fragile tissue	can result in ruptured organs, hernia ect
21	cardiovascular abnormabities	such as mitral valve prolapse
22	pregnancy complications	rupture of womb in late term pregnancy
23	headache	NULL
24	stiff neck	NULL
25	photophobia	increased sensitivity to light
26	altered mental state	confusion
27	brain fog	trouble thinking and concentrating
28	muscle/joint pain	NULL
29	dizzyness	NULL
30	noise sensitivity	some frequences may be unbearable, and some noises may seem much louser than they are
31	persistant cough	NULL
32	respiratory issues	wheezing, breathlessness, exercise intolerance, repeated lung infections
33	poor weight gain and growth	NULL
34	severe constipation	NULL

Update table implemented by trigger is automatically updated also:

update_id	u1	u2
2	6	Cystic Fibrosis