SUPERIOR RELATIONAL DATABASE MANAGEMENT SOLUTIONS INC.

Experts in developing databases for the medical industry.

WHAT IS YOUR BUSINESS ISSUE?

- Health One requires to keep track of health claims including patient information, provider(doctor) information, information about patient visits to their doctor as well as prescription drugs prescribed to patients.

- Information such as patient name, address, phone, email etc. are needed as well as who each patient's primary care doctor is, their insurance ID number and insurance company name.

- Health One also want information on each doctor such as their specialty and what hospitals they are affiliated with as well as their phone, address etc.

- Regarding the hospitals themselves Health One will need to know where they are located and how to contact them.

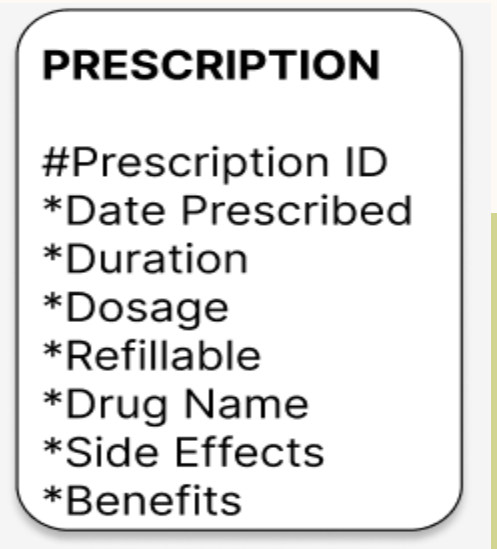
- The prescriptions given to each patient by a health-care provider also need to be tracked in this particular database at this time to determine claim eligibility including some basic information on the drug being prescribed to make sure there are no conflicts with a patient's other prescriptions. We need to know each drug's name, purpose/use and possible side effects.

- Eventually, the database will be used to track trends and for some extrapolative modeling based on the accumulated data. The database will be accessible in English only right now, although plans include making it available in multiple languages eventually.

We used this information to determine entities, their attributes and UIDs to create a preliminary entity relationship diagram (ERD).

Identified Patient entity with Patient ID as UID and mandatory attributes.

Identified Doctor entity with Doctor ID as UID and mandatory attributes.



Identified Prescription entity with Prescription ID as UID and mandatory attributes.

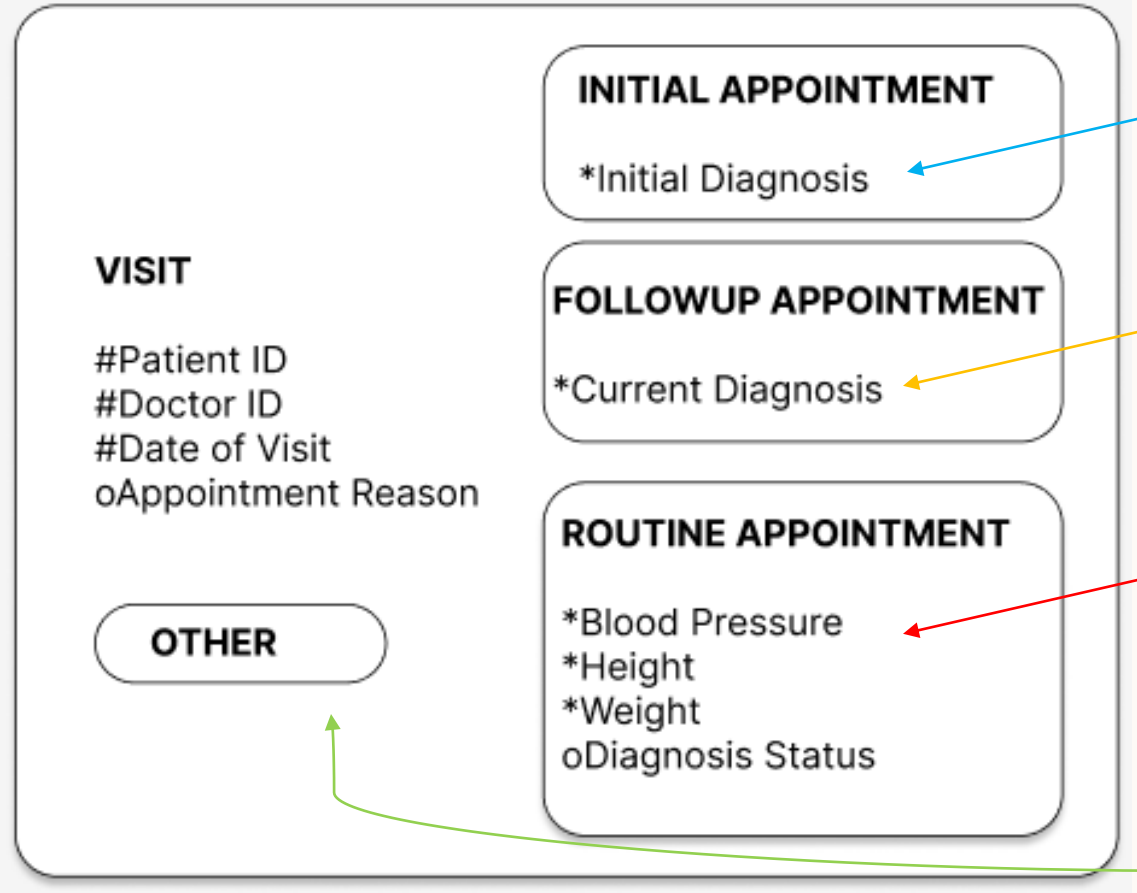
Identified Hospital entity with Prescription ID as UID and mandatory attributes.

IDENTIFYING THE NEED OF A SUPERTYPE AND SUBTYPES

We need to be able to track which type of visit each instance is so we can keep specific information regarding the visit.

So, we went back to our conceptual ERD and determined the need to integrate a Supertype entity because three different appointment entities share similar attributes.

Some patient visits are related to a new issue/illness, some are follow up visits to an existing diagnosis and some visits are routine "well patient" visits or checkups.



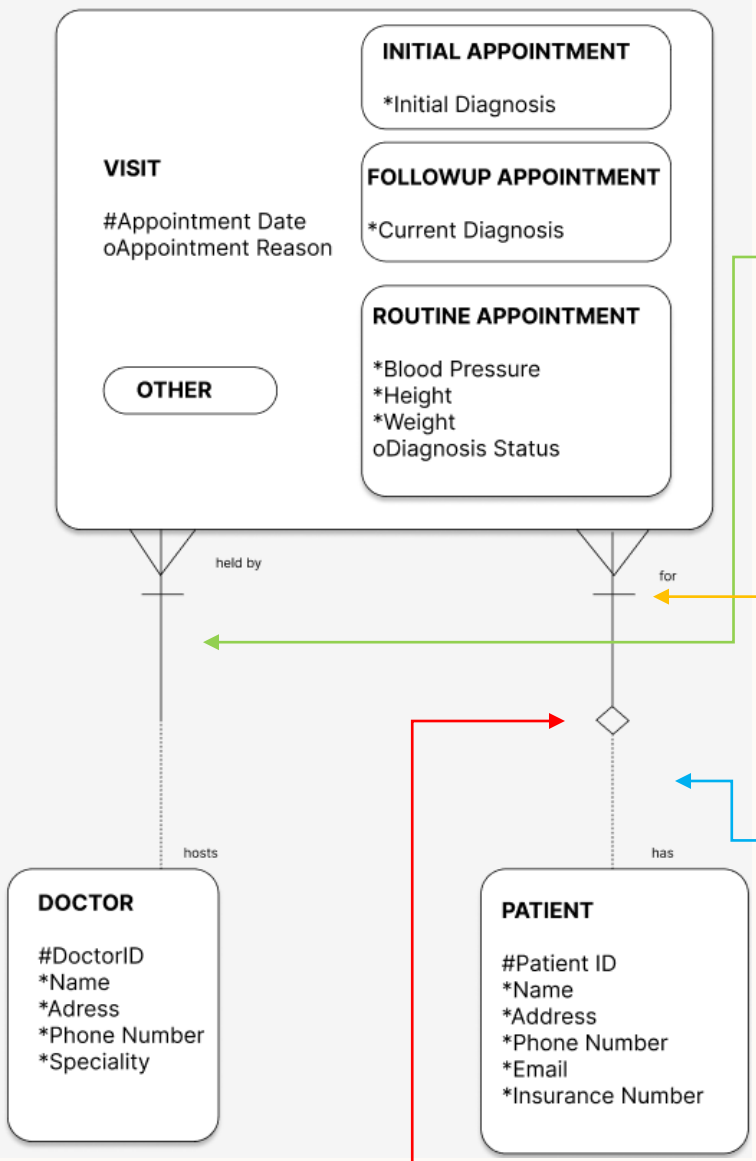
For a new issue/illness we will store a mandatory Initial diagnosis attribute within Initial Appointment subtype.

For follow-up visits we need a mandatory attribute to keep track of the patient's status regarding the diagnosis.

For routine checkups we need to track patient vital information such as blood pressure, height and weight – all as mandatory attributes.

We include an OTHER subtype to ensure our subtypes are exhaustive.

IDENTIFYING RELATIONSHIPS BETWEEN ENTITIES, OPTIONALITY AND CARDINALITY



Each VISIT must be held by one and only one DOCTOR.

This is represented as a mandatory 1:M relationship, as a doctor must be the only person who can host a visit.

Each DOCTOR may host one or more VISITs.

This is represented with optional cardinality, as a DOCTOR may host many different visits.

Each VISIT must be for one and only one PATIENT.

This is represented as a mandatory one to many relationship, as a PATIENT must be a singular person who can have visits.

Each PATIENT may have one or more VISITs.

This is represented with optional cardinality, as a PATIENT may have many different visits.

Both of the 1:M relationships are barred.

The Supertype entity is an intersection entity utilizing UIDs from PATIENT and DOCTOR.

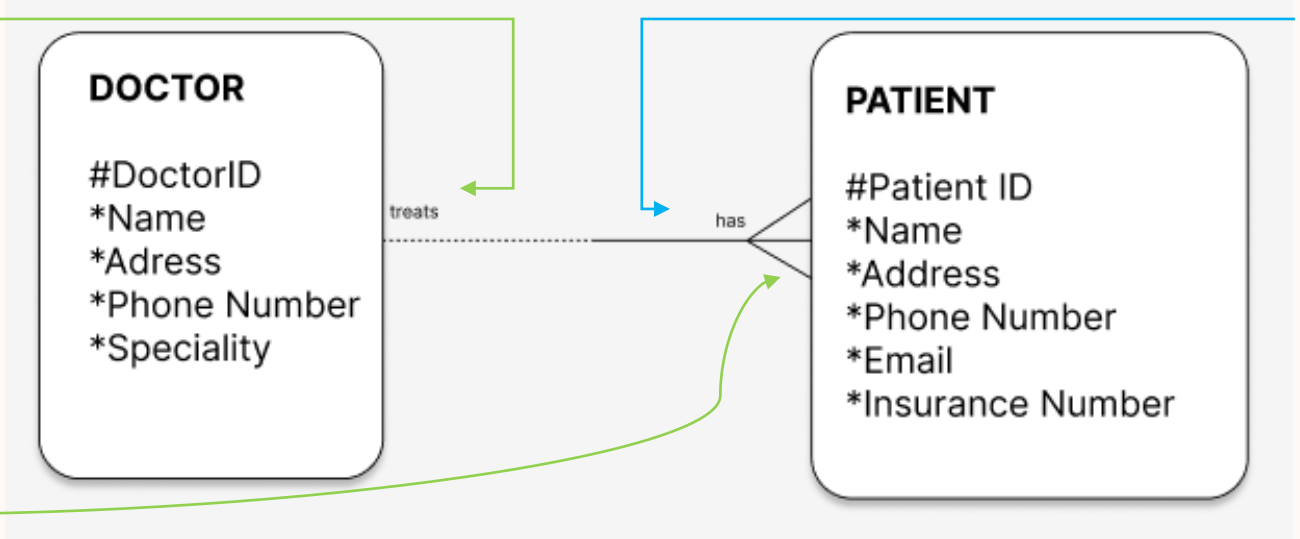
PATIENT and VISIT have a non-transferable relationship.

An alternative PATIENT can't attend another PATIENTs VISIT.

IDENTIFYING RELATIONSHIPS BETWEEN ENTITIES, OPTIONALITY AND CARDINALITY

Each DOCTOR may treat one or more PATIENT.

This is represented with optional cardinality, as a doctor can have many patients.



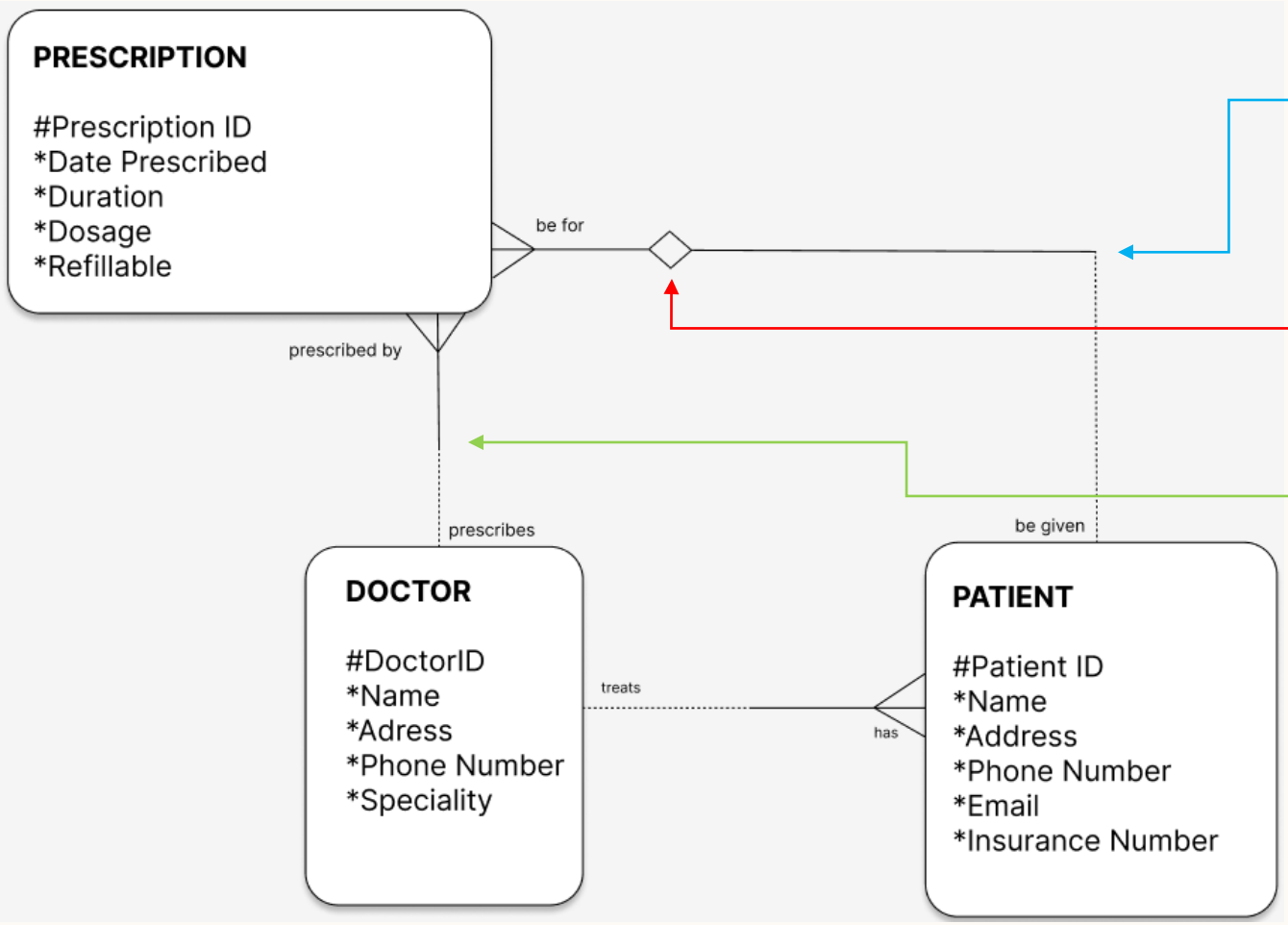
Each PATIENT must have one and only one DOCTOR.

This is represented as a mandatory one to many relationship, as a patient can only have one doctor.

This is a transferable relationship, as a PATIENT can change from one DOCTOR to another DOCTOR and vice versa.

IDENTIFYING RELATIONSHIPS BETWEEN ENTITIES, OPTIONALITY AND CARDINALITY

Intersection Entity between PRESCRIPTION, DOCTOR and PATIENT



Two 1:M relationships.

Each PATIENT may be given one or more PRESCRIPTIONs.

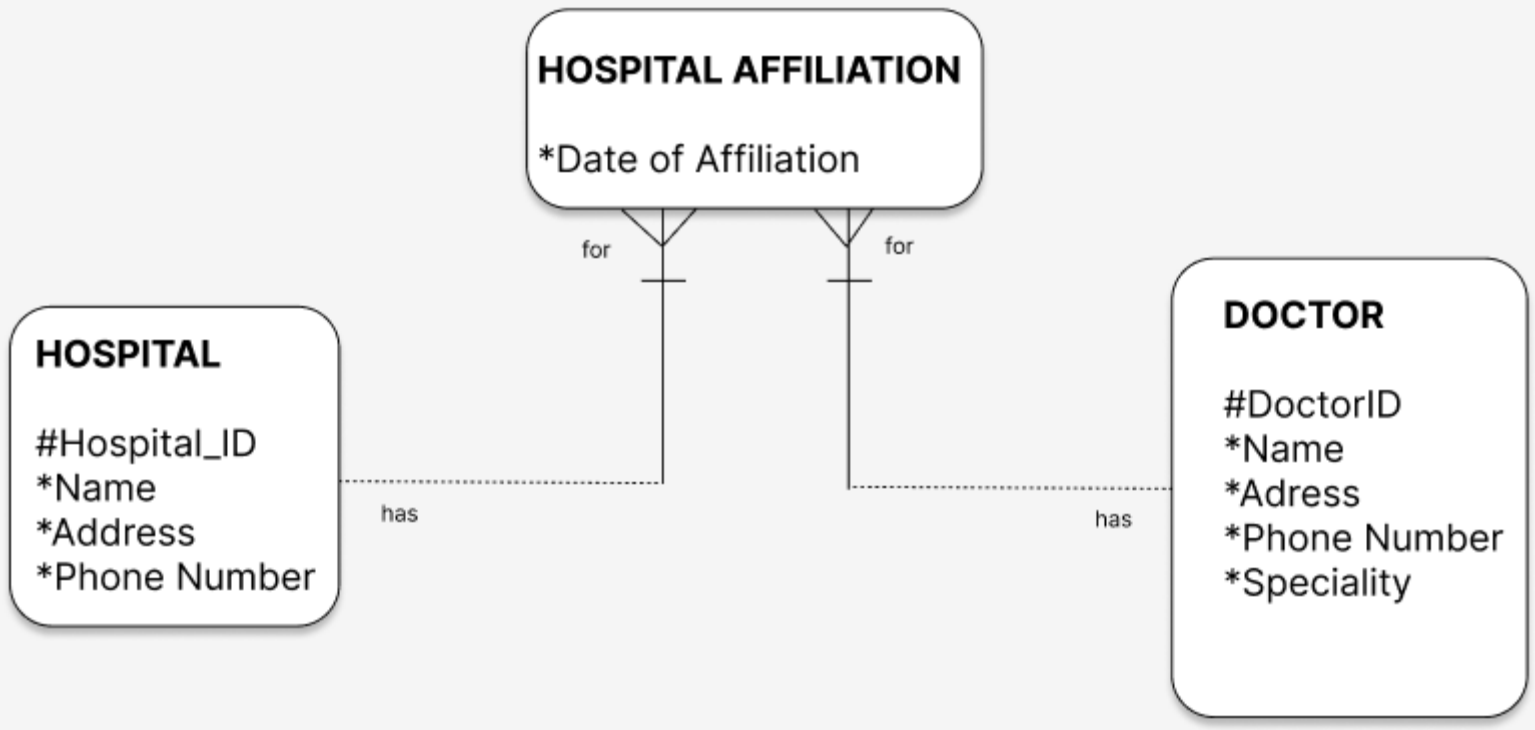
Each PRESCRIPTION must be for one and only one PATIENT.

This is non-transferable relationship, as the same PRESCRIPTION cannot be given to a different PATIENT.

Each DOCTOR may prescribe one or more PRESCRIPTIONs.

Each PRESCRIPTION must be prescribed by one and only one DOCTOR.

IDENTIFYING RELATIONSHIPS BETWEEN ENTITIES, OPTIONALITY AND CARDINALITY



Each DOCTOR may be affiliated with many hospitals and each hospital may have many doctors affiliated with it.

We need to make sure the many-to-many relationships are resolved.

An intersection entity is created, resolving the M:M relationship by including 1:M optionality.

Each DOCTOR may have one or more HOSPITAL AFFILIATIONs.

Each HOSPITAL AFFILIATION must be for one and only one DOCTOR.

Each HOSPITAL may have one or more HOSPITAL AFFILIATIONs.

Each HOSPITAL AFFILIATION must be for one and only one HOSPITAL.

NORMALIZATION OF THE ERD

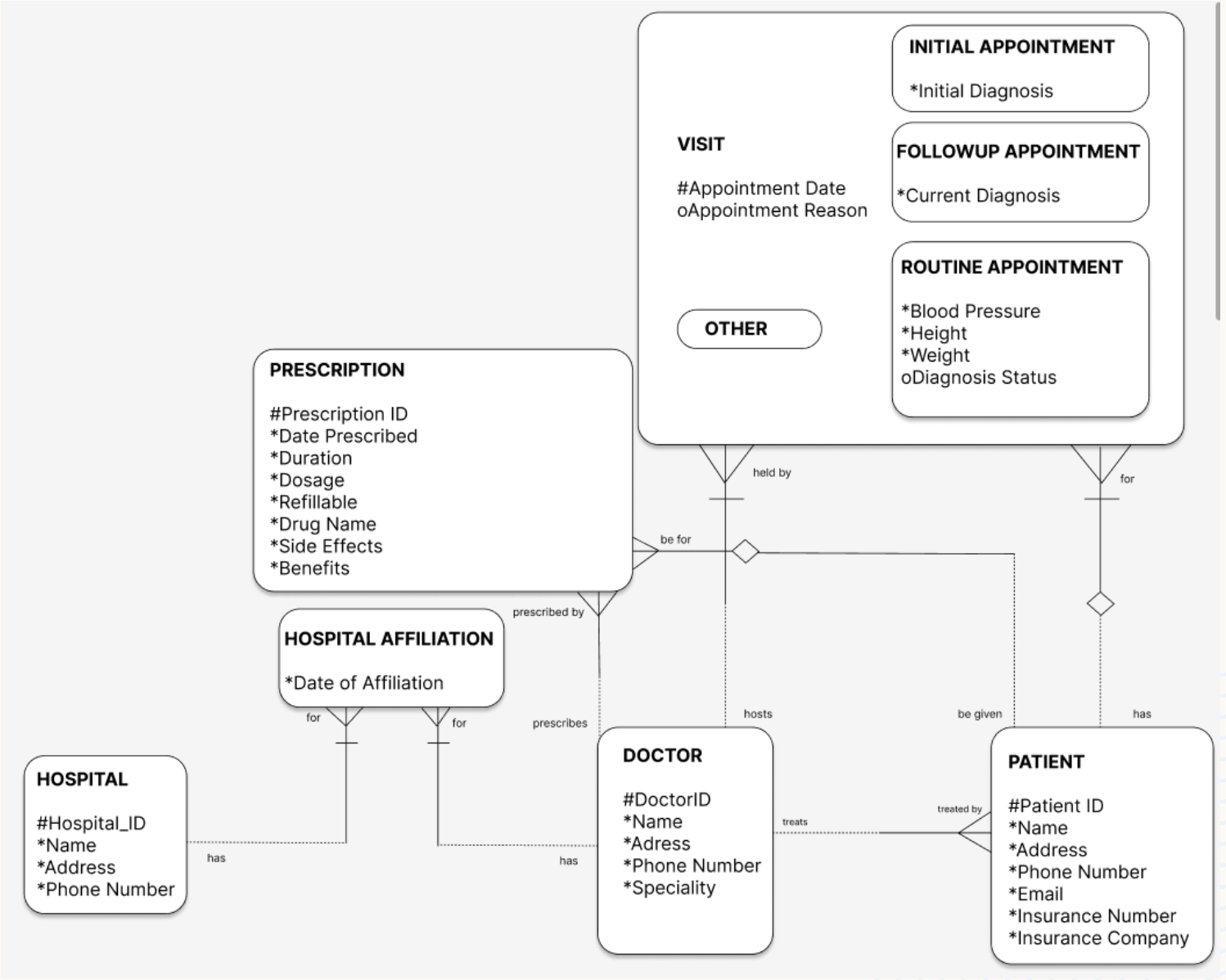
1ST NORMAL FORM

All attributes must have a single value – no multivalued attributes.

So far, this ERD follows this rule.

For example:

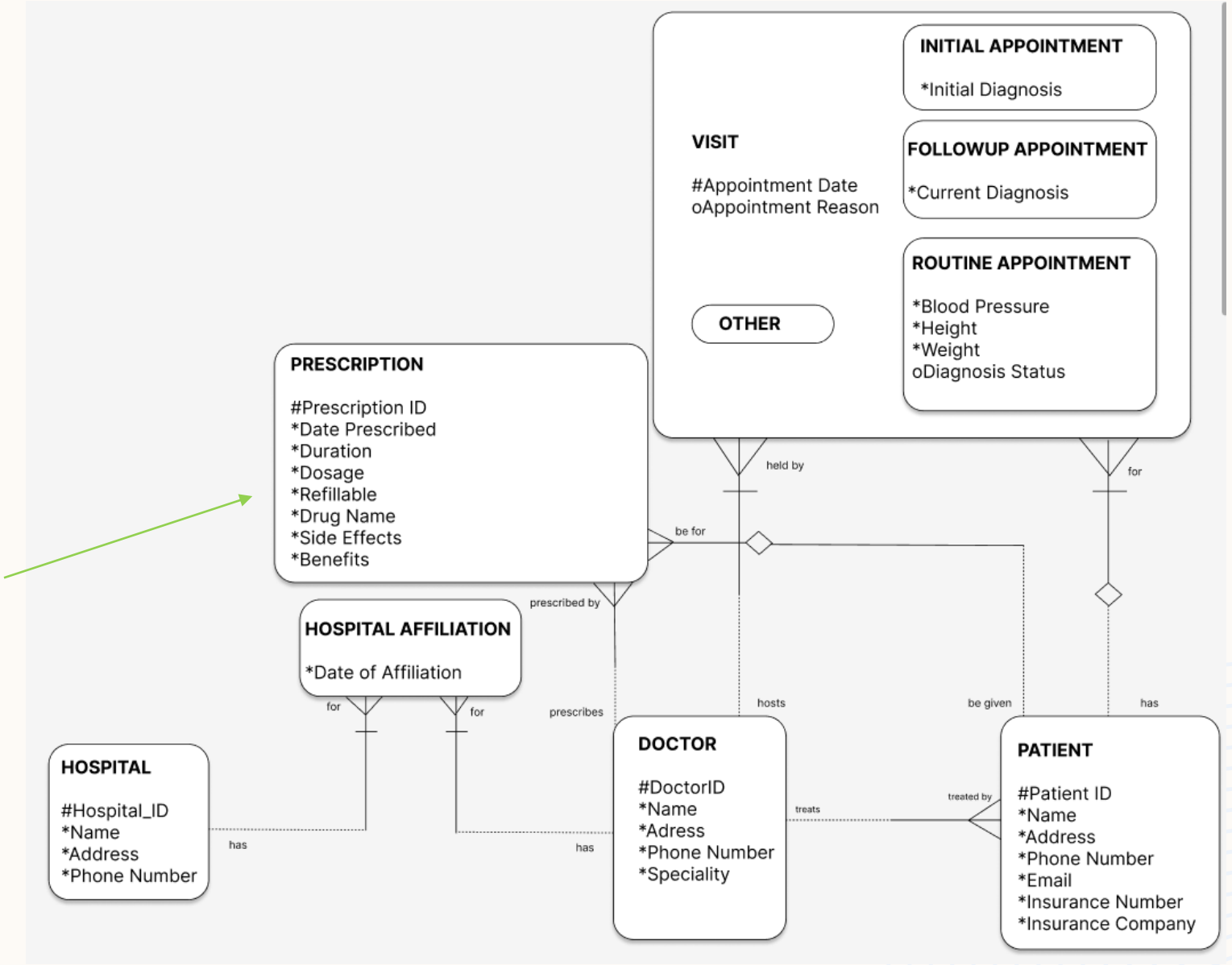
Each patient can only have one primary doctor, each doctor can only have one specialty etc.



2ND NORMAL FORM

All attributes must be dependent on the entire key of the entity.

For example, we need to know each drug's name, purpose and side effects but if we include this in the prescription entity it will be dependent only on what drug is prescribed not who it's for or what doctor prescribed it – so it does not belong in the same entity as the prescription information itself.

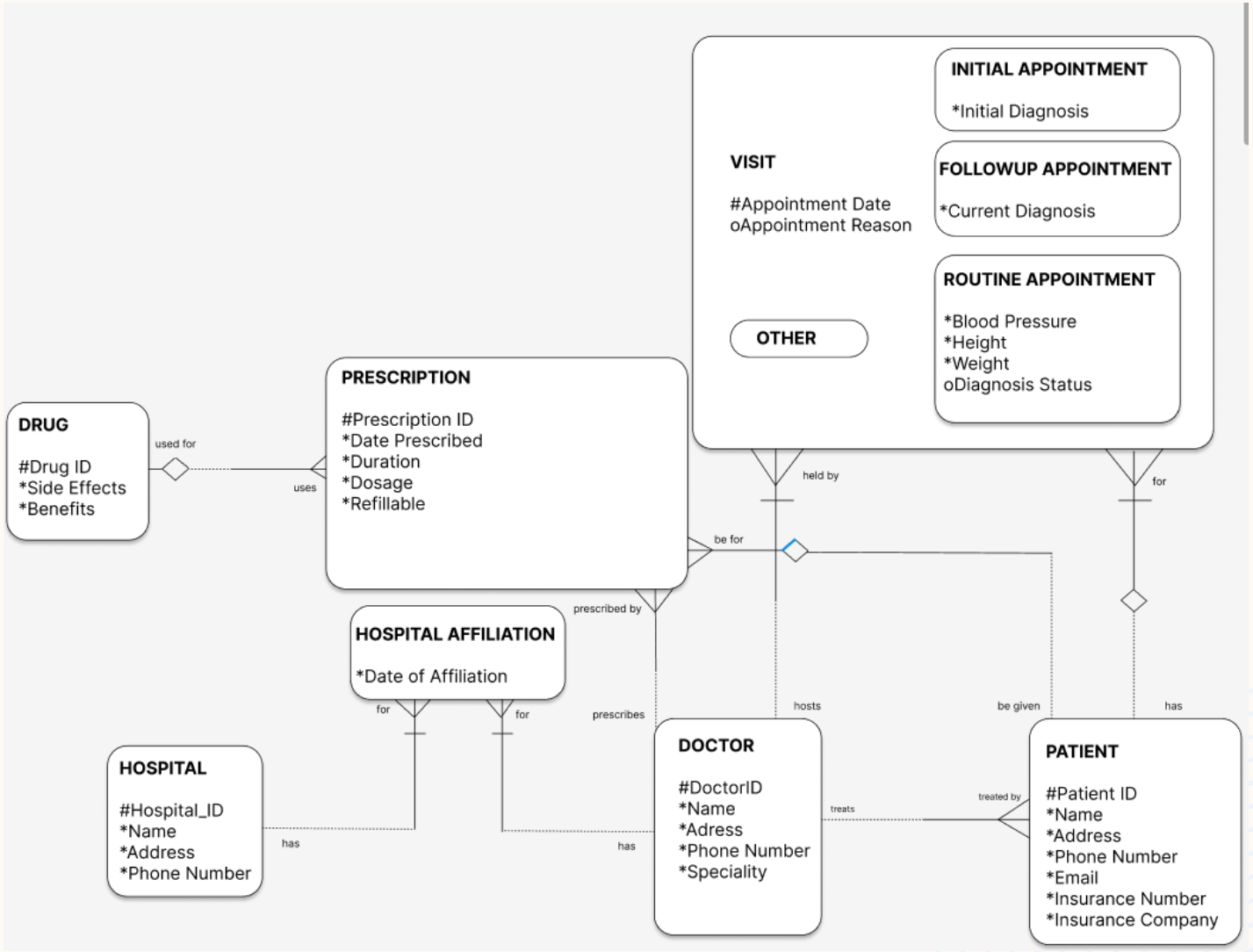


2ND NORMAL FORM

We have resolved this issue by creating a separate DRUG entity.

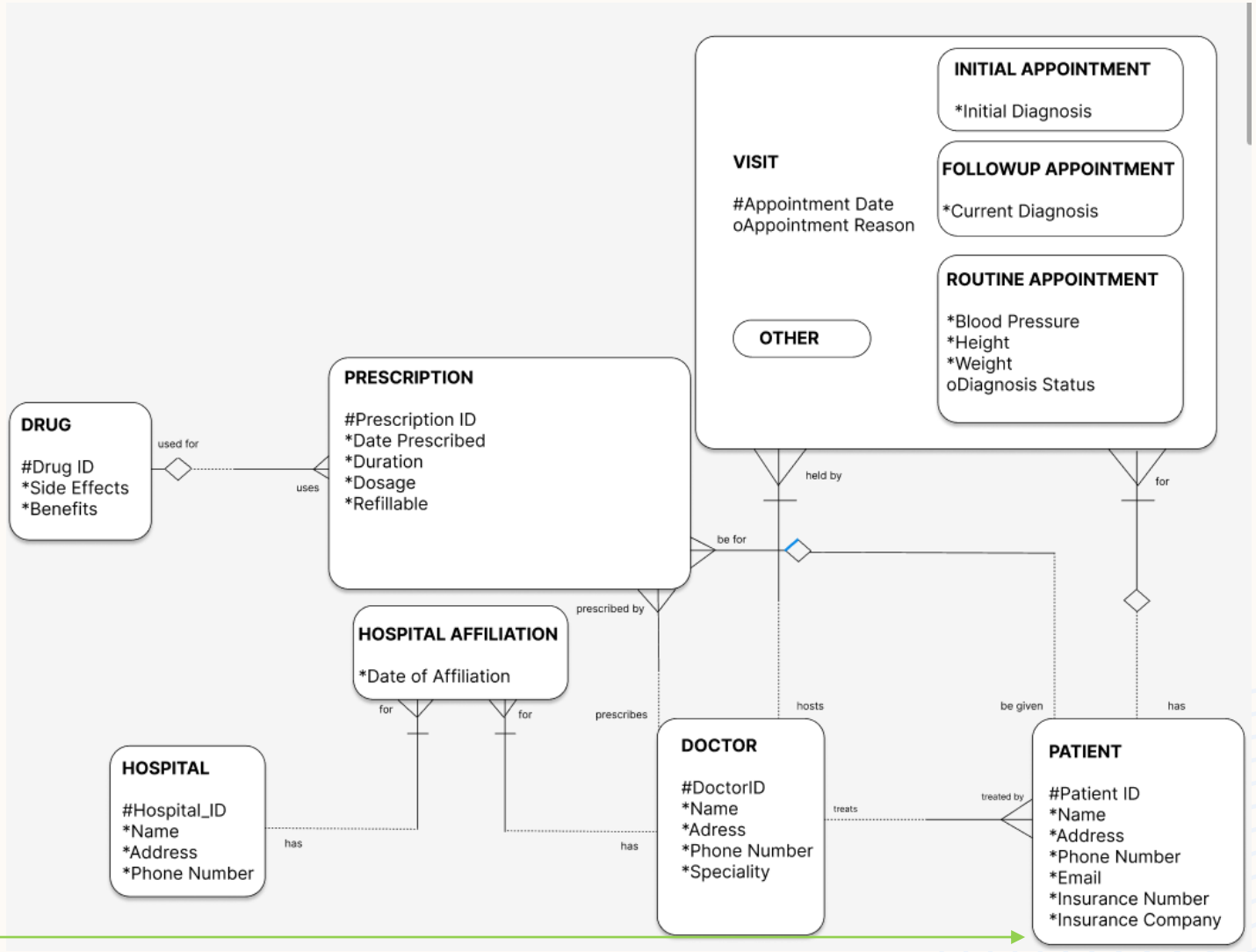
Drug name has been converted into Drug ID as a UID with Side Effects and Benefits attributes being replaced.

This is an optional 1:M and non transferable relationship.



3RD NORMAL FORM

No non-UID attribute can be dependent on another non-UID attribute. For example : A patient's insurance ID number will determine what insurance company they are insured with. The ID number determines the insurance company's name.

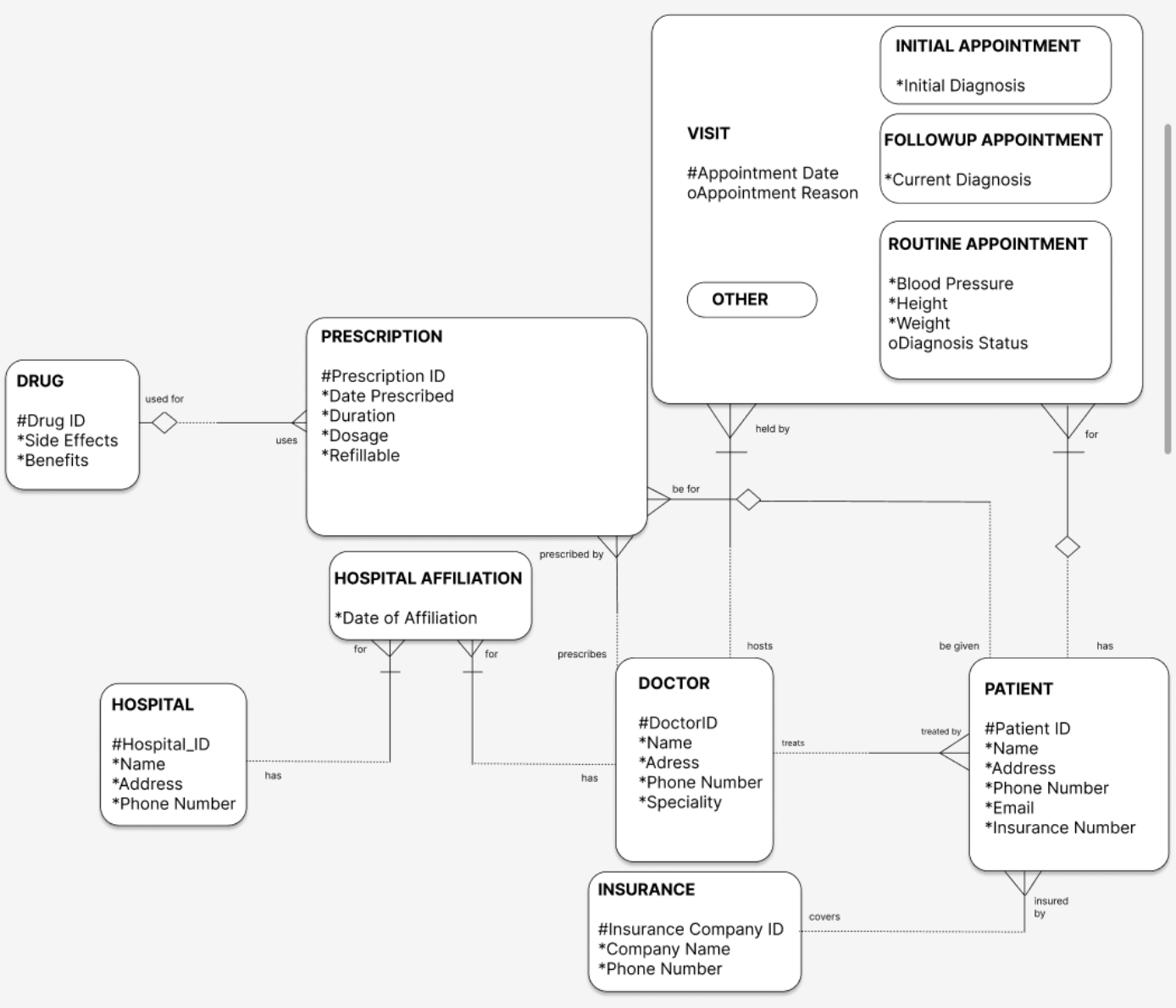


3RD NORMAL FORM

We have resolved this issue by creating a separate INSURANCE entity.

Insurance Company attribute has been removed with an artificial UID created for INSURANCE, alongside Company Name and Phone Number attributes.

This is an optional 1:M transferable relationship.



IMPLEMENTING AN ARC

Each prescription issued by a doctor must be refillable or non-refillable. It can't be both.

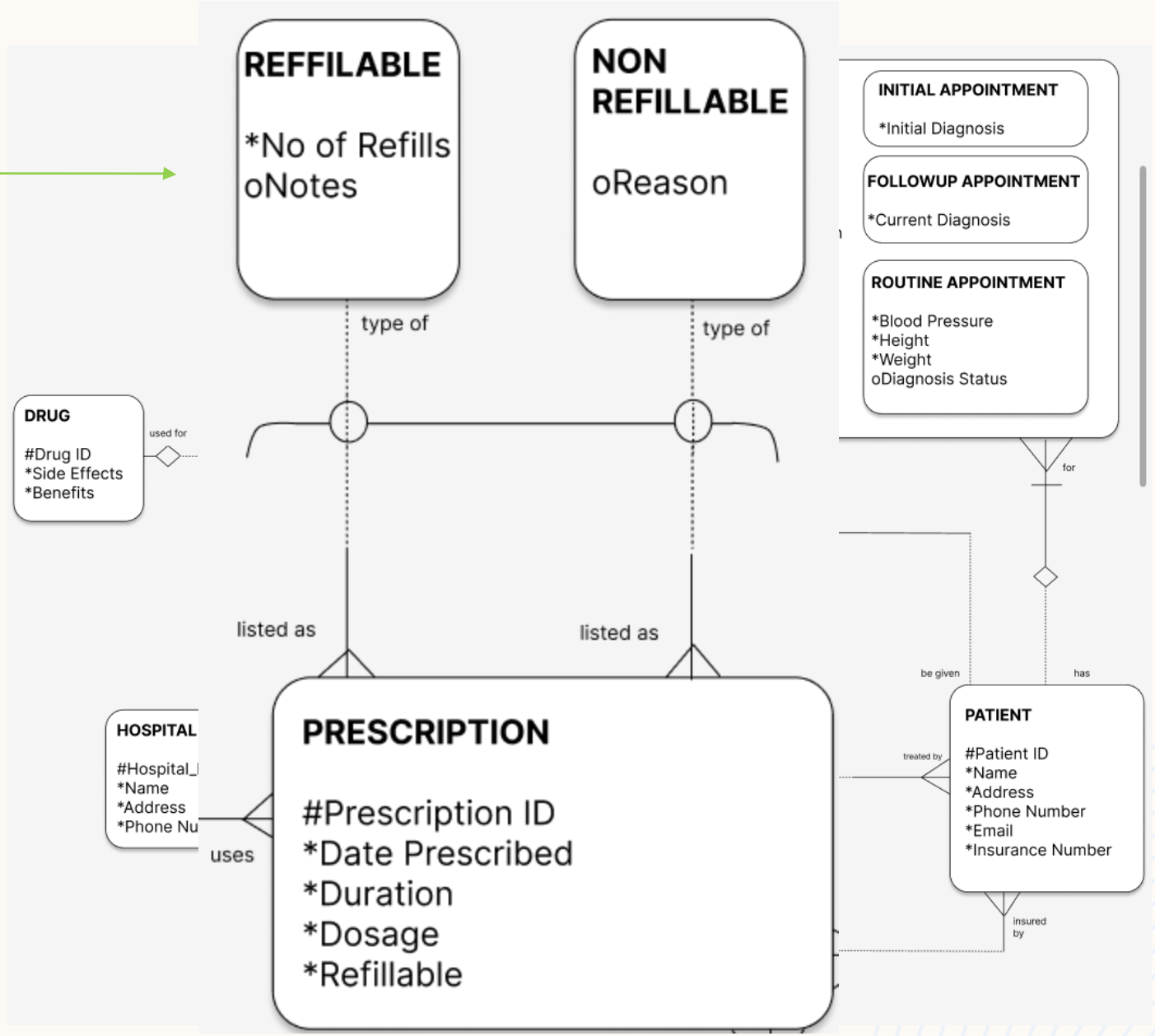
Re-fillable prescriptions will have information about the number and size of refills. All prescriptions will need information about the date, dosage and duration of the RX.

We modeled an arc to represent a new mutually exclusive relationship, splitting into two different entities – refillable and non-refillable.

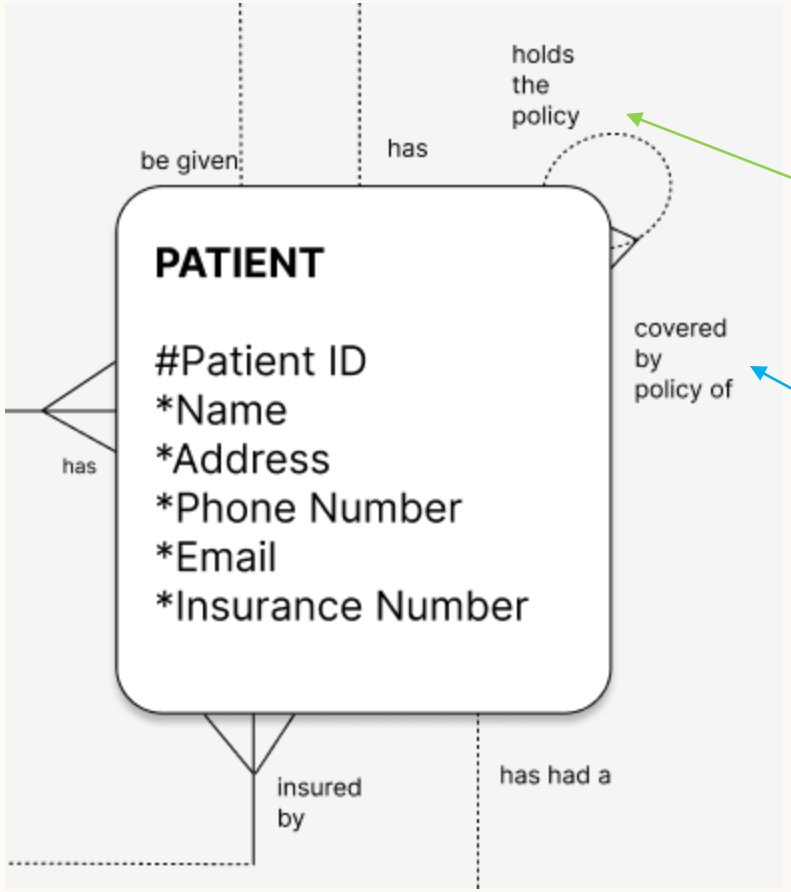
A DRUG PRESCRIPTION must be listed as only REFILLABLE OR only NON REFILLABLE.

No of Refills attribute created and assumptions made to include optional notes attribute.

Both relationships are M:1 with optionality but only one entity can be utilized at a time - not both.



IMPLEMENTING A RECURSIVE RELATIONSHIP



Some patients in the patient entity may be part of the same family and be covered by the same insurance – we need to designate a field in the patient entity showing who is the insurance holder for each patient – this field would be the patient ID number of the person holding the insurance for the family.

We use a loop (a pigs ear) to visualize this type of relationship.

Each PATIENT may hold the policy of one or more PATIENTs.

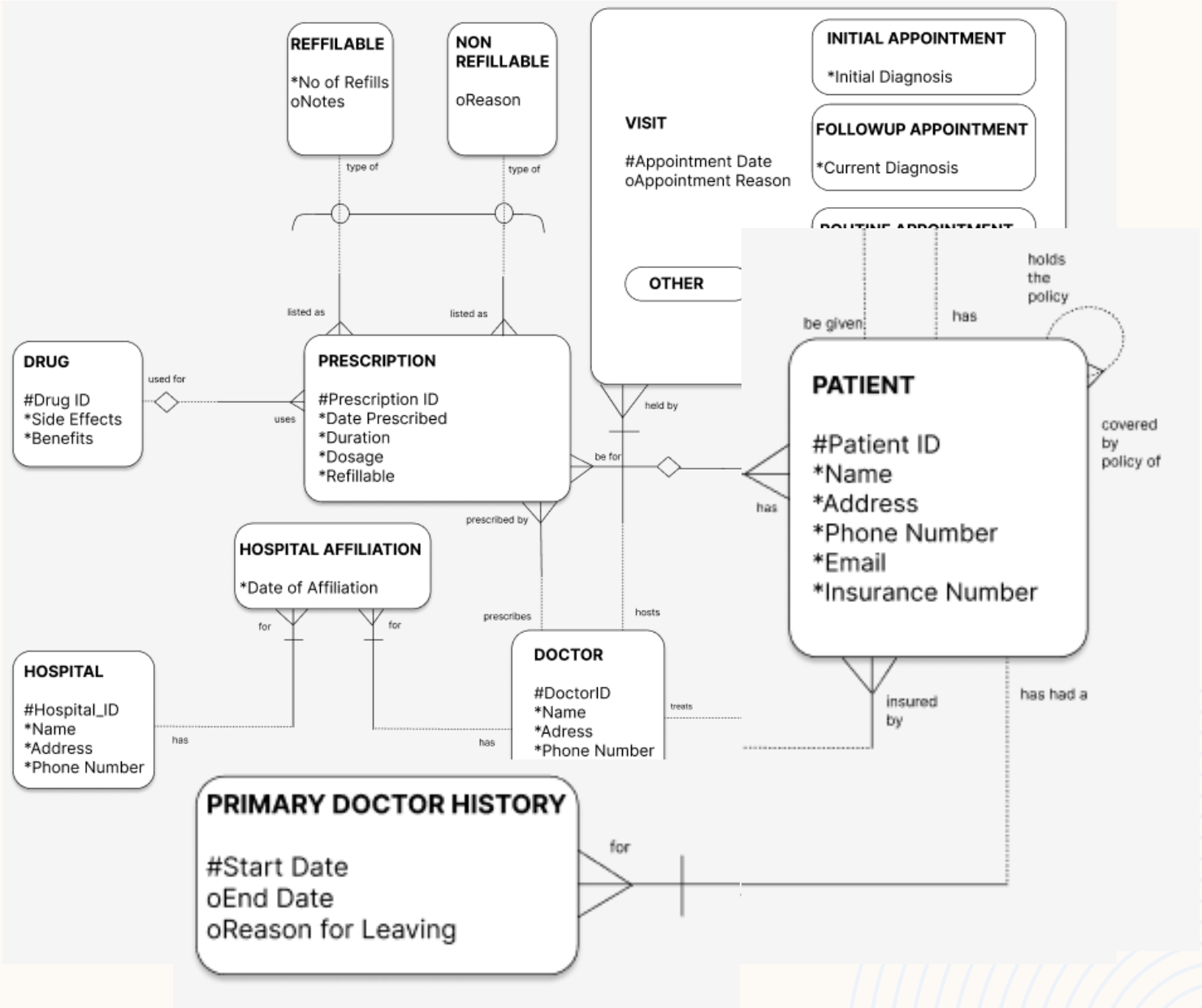
Each PATIENT may be covered by the policy held by one and only one PATIENT.

MODELING HISTORICAL DATA

For use in analyzing providers (doctors) and their effectiveness – if a patient changes primary care doctors we need to be able to keep track of these changes. This will also aid in patient care tracking throughout their life. We need to be able to keep a record of each patient's charts and which doctors may have provided information on them.

The end date is optional because the PATIENT may have never changed doctor.

This is an optional 1:M barred relationship using Patient ID and Start Date as PRIMARY DOCTOR HISTORYs UID.



FINAL ERD SOLUTION

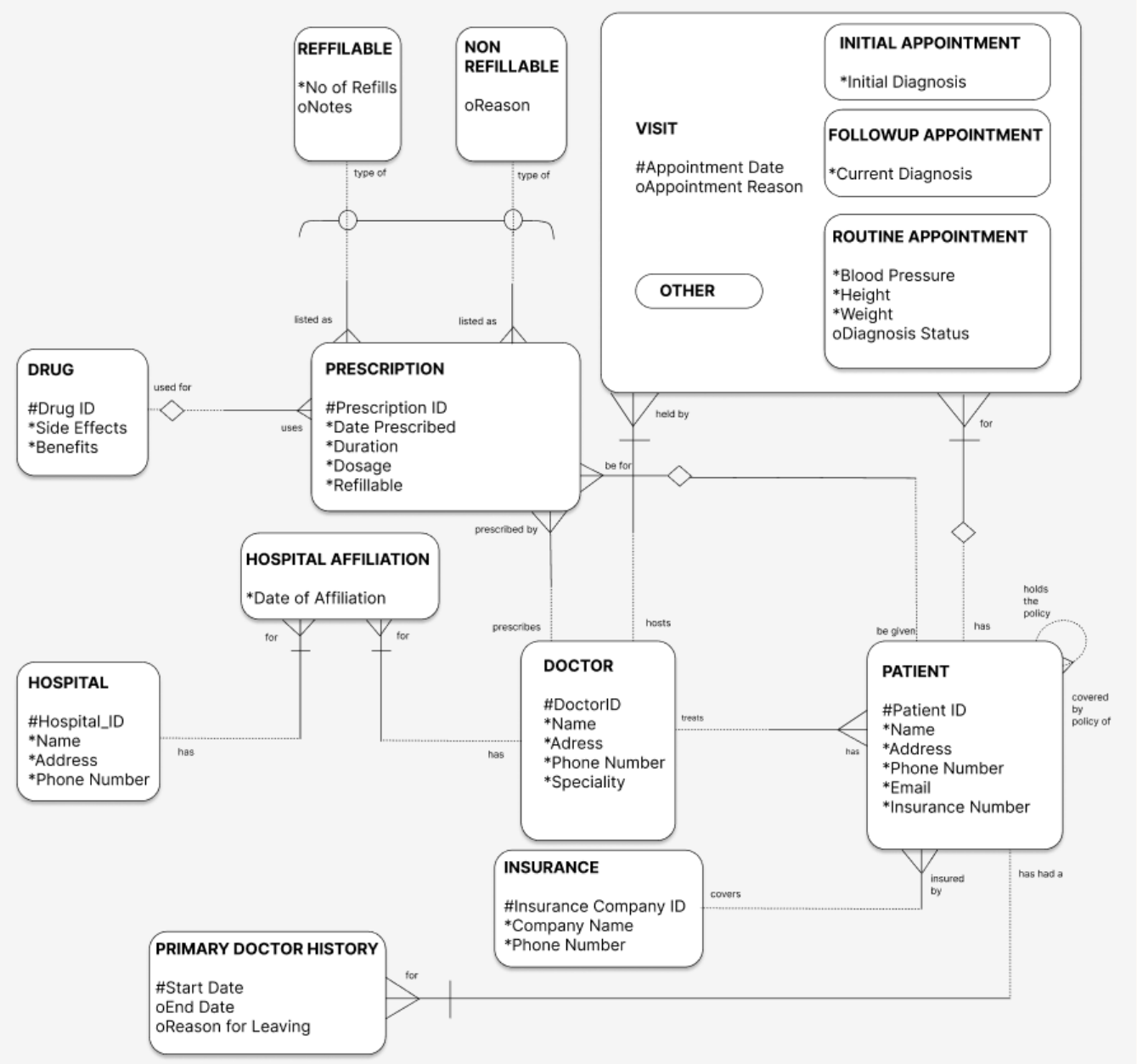


TABLE MAPPING

Patient		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK	*	PatientID
	*	Name
	*	Address
	*	Phone Number
	*	Email
FK	*	Insurance_Number
FK	*	Primary_Doctor
FK	*	Policy_Holder

Doctor		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK	*	Doctor_ID
	*	Name
	*	Address
	*	Phone Number
	*	Speciality

TABLE MAPPING

Insurance		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK	*	Insurance Company ID
	*	Company Name
	*	Phone Number

Prescription		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK	*	PrescriptionID
	*	Date_Prescribed
	*	Duration
	*	Dosage
	*	Refillable
	o	No_of_Refills
	o	Notes
	o	Reason
FK	*	Patient_ID
FK	*	Doctor_ID
FK	*	Drug_ID

TABLE MAPPING

Drug		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK	*	Drug_ID
	*	Side Effects
	*	Benefits

Hospital		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK	*	Hospital_ID
	*	Name
	*	Address
	*	Phone Number

Hospital		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK	*	Hospital_ID
	*	Name
	*	Address
	*	Phone Number

TABLE MAPPING

Hospital Affiliation		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK, FK	*	Doctor_ID
PK, FK	*	Hospital_ID
	*	Date_of_Affiliation

Visit		
Key Type (PK,FK,UK)	Optionality (* or o)	Column Name
PK, FK	*	Patient_ID
PK, FK	*	Doctor_ID
PK	*	Date_of_Visit
	o	Appointment_Reason
	o	Initial_Diagnosis
	o	Current_Diagnosis
	o	Blood_Pressure
	o	Height
	o	Weight
	o	Diagnosis_Status

ASSUMPTIONS

- Initial visits made by customers are to primary care doctors.
- Doctors work in public hospitals and not private practices
- Customers can have policies that cover more than one person

BUSINESS RULES

- One Patient may visit many times
- One visit must have one patient
- Visits are non transferable
- Medicine can be non-refillable
- Medicine can be refillable
- One prescription may have one or more drugs
- One or more medicines must have one prescription
- One Patient may have many prescriptions
- One Prescription must have one patient
- Prescriptions are non transferable

BUSINESS RULES

- One or more Hospital Affiliations must have one hospital
- One Doctor must have one or more affiliations with hospitals.
- One hospital can have many affiliations
- One or more affiliations must have one hospital
- One Patient may have history
- A Doctor looks at one Patients History.
- A Patients History can be looked at by a Doctor.
- Business Rules: Doctor - Visits
- A doctor can have many visits
- A Visit must be with a Doctor
- A Doctor can be affiliated with many Hospitals.
- A Hospital Affiliation must have one Doctor.
- A Doctor must be a Person.
- A patient has one Doctor.
- A doctor may have many Patients
- One insurance policy can have one Patient
- One Person can have one insurance policy

RECOMMENDATIONS

THANK YOU
FOR YOUR TIME

ANY QUESTIONS?