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IST 659 Part One Project Deliverable **2/17/2019**

Part one: Design

Project Background

The American Society of Clinical Oncology (ASCO) is an association of oncologists who care for people with cancer. Recently, the Board of ASCO has decided to conduct internal research on breast cancer with the objective of testing a new breast cancer medication. The study consists of 2000 patients and 10 Oncologists. In order to be able to run a study like this, effective documentation and tracking of resources is extremely essential and a database management system (DBMS) solution would be extremely beneficial, but first, the database must be designed effectively and efficiently to comply with the needs of the researchers that are conducting the study. ASCO does not currently have a database system designed to conduct such studies. And oncologists are in fact using an excel sheet where all patients' records are kept. The database must be designed so that only those who are authorized to access certain information (Researchers) are able to do so.

Requirement Gathering

I start designing Breast Cancer Patient Record system by gathering the facts and requirements about a breast cancer names, different kinds of treatments, and generic patient entity first. To determine an appropriate approach to treating the disease, it is a must to know the type of breast cancer. Based on this, oncologists determine the kind of breast cancer treatment to a specific patient as there are different kinds of treatment to it like surgery, chemotherapy, hormone therapy, radiation therapy, and targeted therapy.

A patient record should store information about patient's identity differentiated by a unique patient id, first and last name, date of birth, gender, address, contact phone number and email address. As for the manipulation of a patient treatment data, two roles are defined: an oncologist, and a nurse. ID number, name and their phone data are required about oncologists. An oncologist orders a treatment for each patient and makes a bi-monthly visit. Following a visit, an oncologist can add, modify, or delete her/his treatment records for a patient. He/she can view the complete treatment records of the patients assigned to him/her.

In addition to ID number and name, specialty of a nurse is required as there are different treatment types and that all nurses can't support patients in their stay. The patient visit data can also be manipulated by a nurse, though with lesser rights granted this time. Normally, a nurse

should be able to add health related treatment record for a patient. A nurse should also be able to browse the visit history of a patient in a restricted way as well as his visit date and time, which means that a nurse cannot view the detailed treatment records of oncologist(s) about a patient.

Business Rules

The following business rules must be met

- ◊ Only patients who have one type of breast cancer is considered in this research.
- ◊ Each patient can only have one treatment at a time
- ◊ An oncologist visits and treats at least one patient but one patient is followed up by one oncologist only
- ◊ Oncologists can only see their own patients and update information regarding their patient
- ◊ Oncologists must see their patients bi- monthly
- ◊ Nurses only enter vital signs including blood pressure, heart rate, and weight
- ◊ Access should be provided to patients with the ability to view their medical records and oncologists' notes
- ◊ Only one phone and email address of a patient is required

Data Questions

This database system should be able to support researchers in answering the following data Questions:

- ♦ Which patient has what kind of breast cancer?
- ♦ Which patient takes what type of treatment?
- ♦ What are the most/dominant breast cancer type and preferred treatments by oncologist?
- ♦ Which treatment type has most drop out patients
- ♦ Which age range is highly impacted by breast cancer?
- ♦ Which oncologist visits more patients and most placed treatment?
- ♦ Which nurse follows up more patients and in which specialty area of nurses are more required?

Data Dictionary

After reviewing the existing excel format that are used collecting patients' information to conduct this type of study, the following list of entities and attributes are identified as shown below in Table 1.

Table1: Breast Cancer Treatment Systems Data Dictionary

Entity	Attribute	Properties
Breast Cancer	Breast Cancer Id	Required and unique
	Breast Cancer Type	Required
Treatment	Treatment Id	Required and unique
	Treatment Type	Required
Patient	Patient Id	Required and Unique
	Name	Required. Composite of First and Last name
	Date of Birth	Required
	Gender	
	Phone Number	
	Address	Required. Composite of Street number, city, state and zip code
	Email	
PatientVisitHistory	PatientVisitHistoryID	Required and Unique
	BloodPressure	Required
	Pulse	
	Weight	
	OnclogistNote	
	dropStatus	
Oncologist	Oncologist Id	Required and Unique
	First Name	Required
	Last Name	Required
	Phone Number	
Nurse	Nurse Id	Required and Unique
	First Name	Required
	Last Name	Required
	Specialty	Required

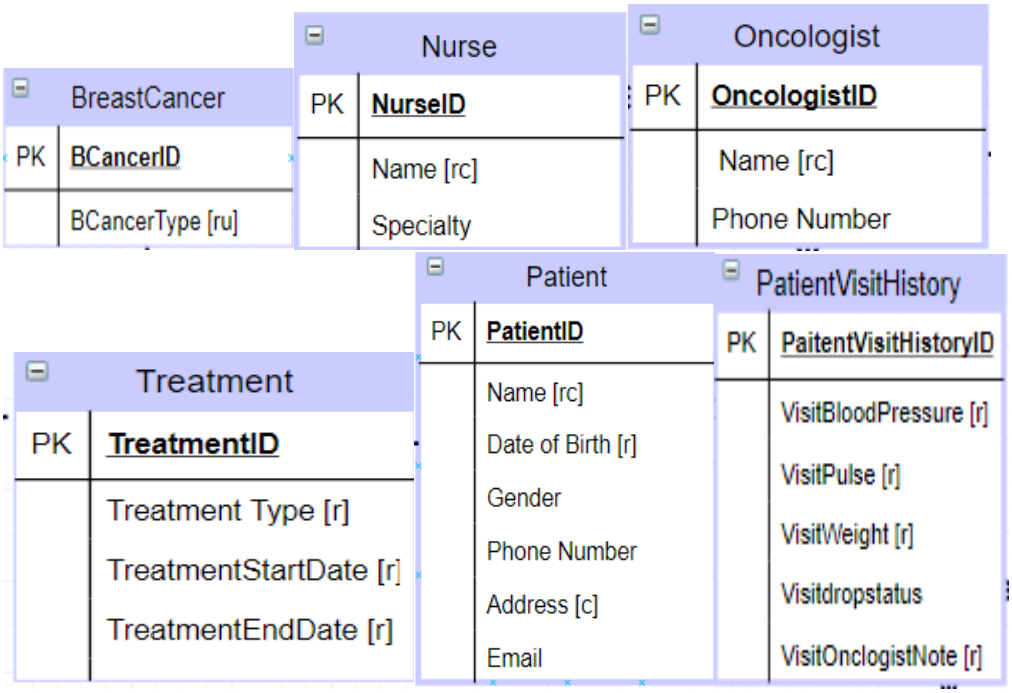
Conceptual Model

Entity-Relationship Diagram (E-R) is used to show the conceptual model of the database design. To draw an E-R diagram, the following two tasks are required:

A) Identify entities and their attributes

As it is shown in Table 1 above, the below six entities with their attributes are identified from the requirement and data problem of this project They are: -

- Breast Cancer
- Treatment
- Patient
- Patient Visit History
- Oncologist
- Nurse



B) Identify cardinalities and degree of relationship

Based on the requirement of the system, the below relationships between entities are identified

- A patient has only one breast cancer type, but many patients can have the same cancer type.
- A patient takes only one treatment at a time, but many patients can take the same treatment.
- Each patient has one or more patient visit history.
- Each oncologist can visit and treat one or more patients, and a patient can be visited by one or more oncologists.
- Each nurse can record one or more patients, and a patient's info can be recorded by one or more nurses.
- Each patient visit history may be updated by one or more oncologists/nurses and each oncologist/nurse can update zero or more patient visit history.

C) E- R Diagram of the system

Figure 1 below illustrates the E-R diagram of the proposed database for ASCO Breast Cancer Research. The model includes the entities, their attributes, and their relationships. The model provides a snapshot of the general relationships between the entities.

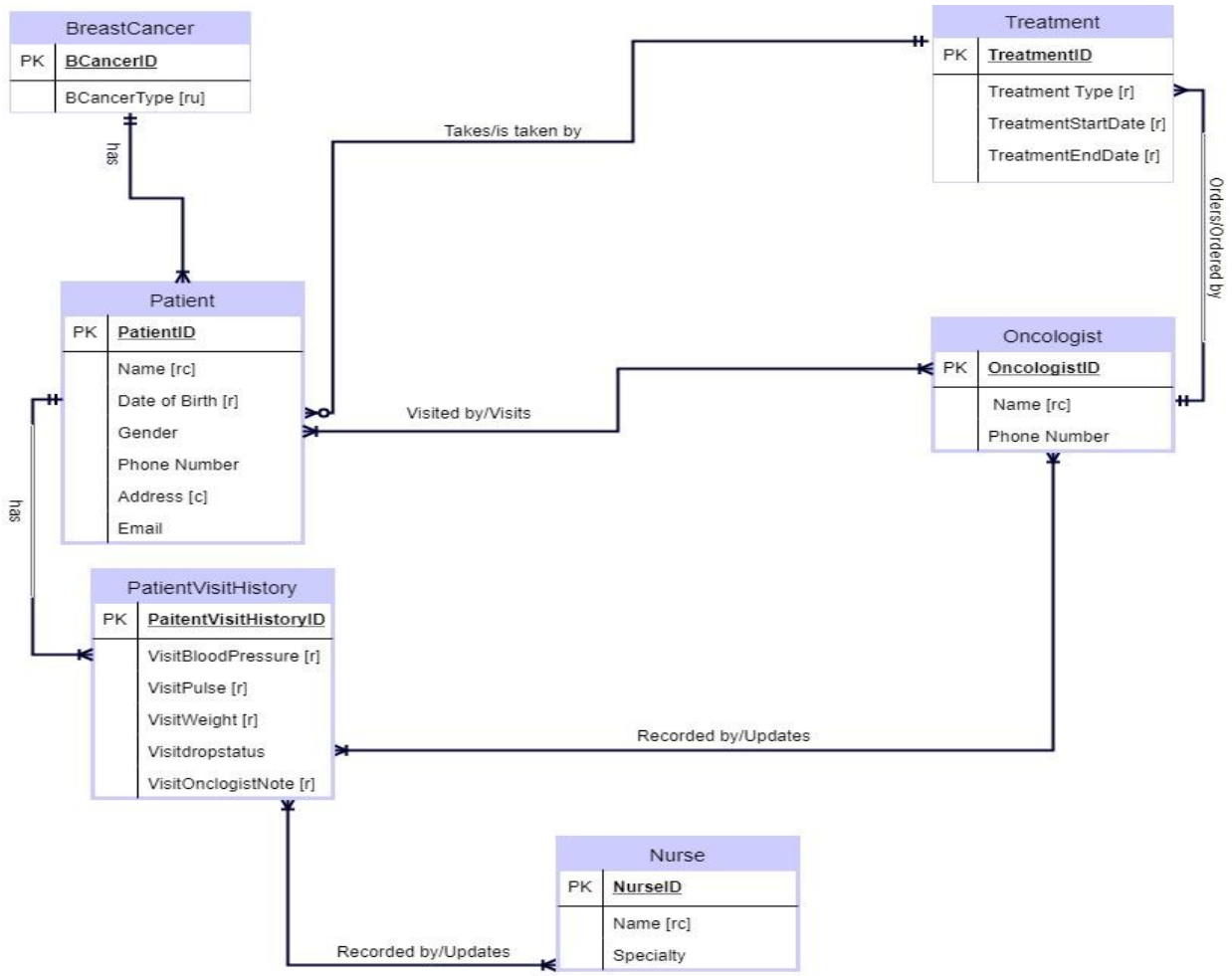


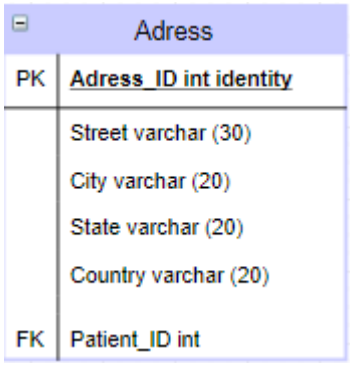
Figure 1. Conceptual Model of ASCO Breast Cancer Research Database

Logical Model

Enhanced E-R diagram is used to show the logical model of the database system. Three mappings are done during transferring from a conceptual model (E-R Diagram) to logical model of Enhanced E-R diagram. These are:

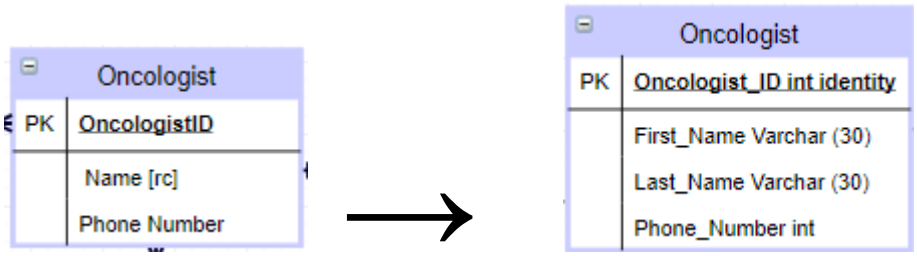
A) Entities are mapped into tables
B) Attributes are mapped into columns
   - Assign primary keys to tables and also indicate unique keys
   - Data type and length for each column is assigned according to the requirement
   - Create new tables for multivalued attributes

In my case patient address is multivalued and a new table called Address is created.



- Decompose composite attributes into their constituent parts
  - *Ex: The "Name"* attribute in patient, oncologist and nurse is identified as composite and decomposed into "*first_name*" and "*last_name* "of its respective entities.

  See Oncologist table as an example:



C) Relationship between entities will be changed to relationship between tables

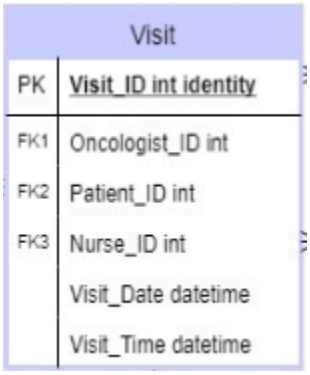
- One-to-One Relationships
  - patient and patient_address tables have a one-to- one relationship
    A primary key of patient table i.e. patientid serves a foreign key in patient_address table

- One-to-Many Relationship
  - ❖ Breast cancer to patient
  - ❖ Treatment to patient
  - ❖ Oncologist to Treatment

- ❖ Patient to PatientVisitHistory

- Many-to-Many relationship
  - Oncologist to patient
  - Nurse to patient
  - Oncologist to Patientvisithistory
  - Nurse to Patientvisithistory

To address the Many-to-Many relationship, a new table called "*visit*" is created.



D) Enhanced E-R Diagram

Figure 2 displays Enhanced E-R diagram of the database system of ASCO Breast Cancer research which shows tables, columns, constraints, data type and length with their relationships.

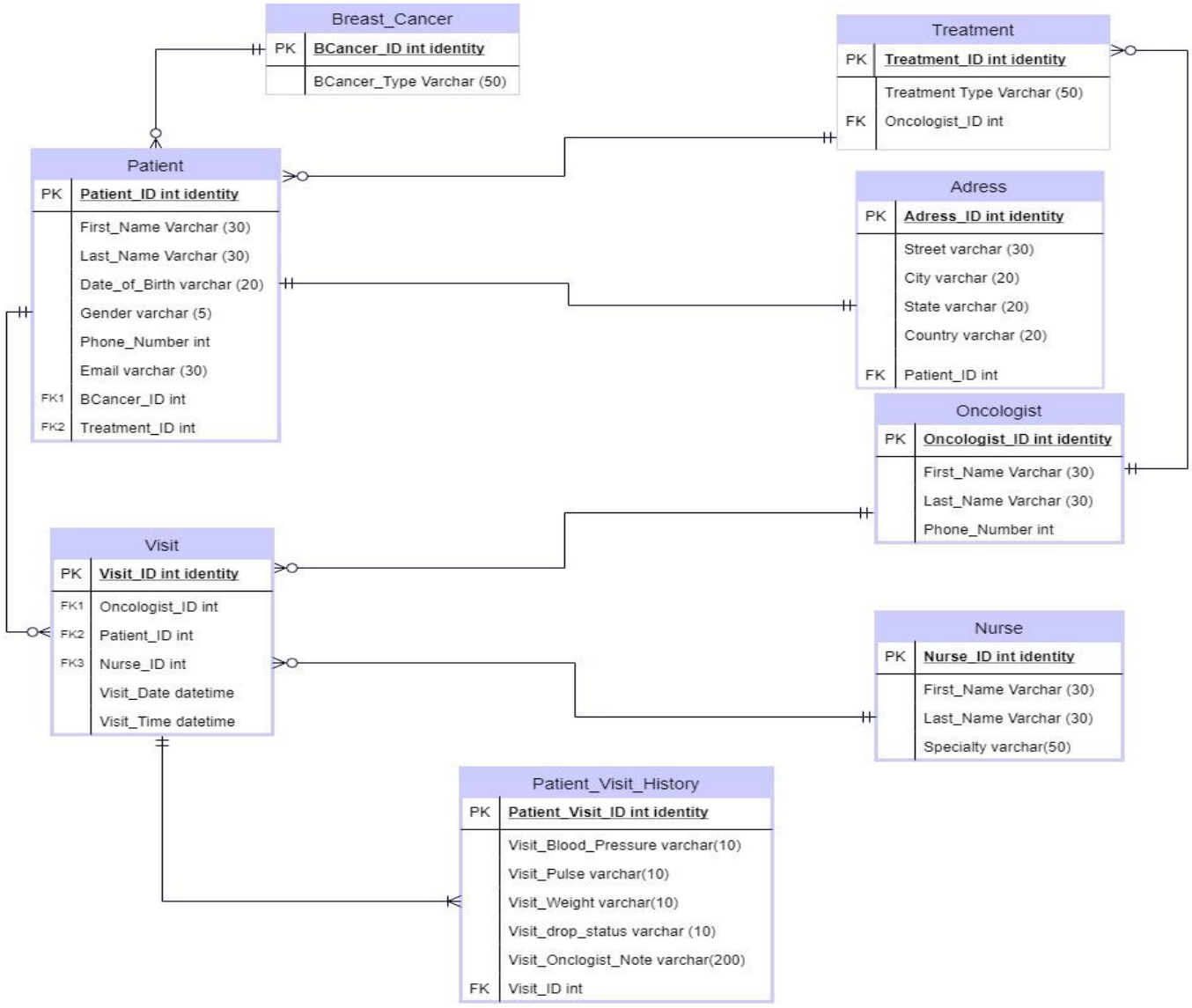


Figure 2 Enhanced E-R Diagram of ASCO Breast Cancer research Database

Normalized Model

A lot of changes have been already made in my logical model and so the logical model is in its normalized form, here are the final tables

- Breast_Cancer (BCancer_ID, BCancer_Type)
- Treatment (Treatment_ID, Treatment_Type)
- Patient (Patient_ID, First_Name, Last_Name, Date_of_Birth, Gender, Phone_Number, Email*, Bcancer_ID*, *Treatment_ID*)
- Address (Address_ID, *Patient_ID*, Street, city, State, Country)
- Oncologist (Oncologist_ID, First_Name, Last_Name, Phone_Number)
- Nurse (Nurse_ID, First_Name, Last_Name, Phone_Number)
- Patient_Visit_History (Patient_Visit_History_ID, Visit_Blood_Pressure, Visit_Pulse, Visit_Weight, Visit_drop_status, Visit_Oncologist_Note, *Visit_ID*)
- Visit (Visit_ID, *Patient_ID*, *Nurse_ID*, Visit_Date, Visit_Time)