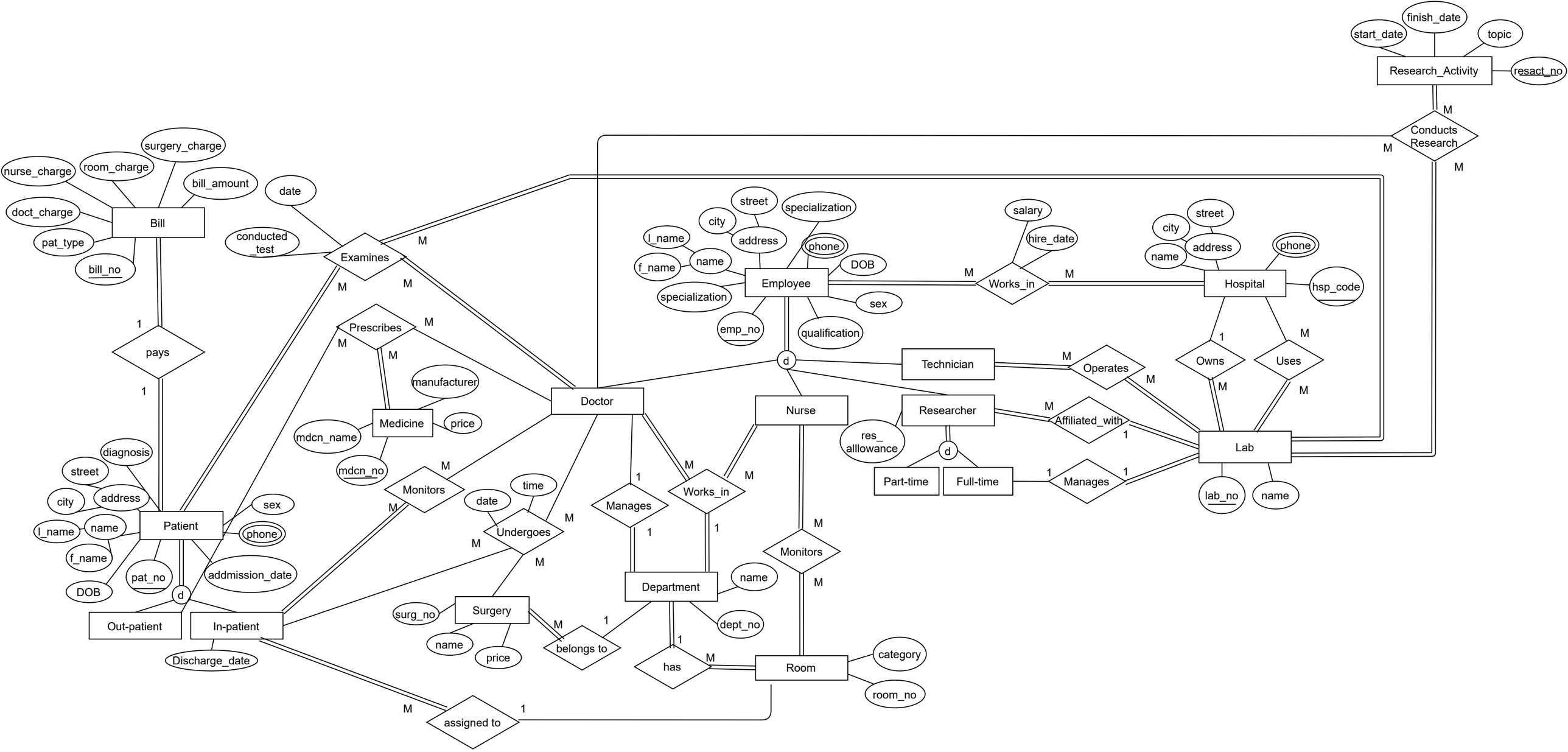
finish_date
start_date
topic
Research_Activity
resact_no
M
Conducts Research
M
M
surgery_charge
nurse_charge
room_charge
bill_amount
date
Bill
doct_charge
pat_type
bill_no
conducted _test
Examines
M
M
M
1
pays
1
Prescribes
M
M
M
manufacturer
Medicine
price
mdcn_name
mdcn_no
Monitors
M
M
diagnosis
street
city
address
l_name
name
f_name
DOB
Patient
sex
phone
pat_no
addmission_date
d
Out-patient
In-patient
Discharge_date
M
assigned to
1
Doctor
time
date
Undergoes
M
M
M
M
Manages
1
1
Works_in
M
M
1
Surgery
surg_no
name
price
M
belongs to
1
Department
name
dept_no
1
has
M
Room
category
room_no
Nurse
Monitors
M
M
street
city
address
l_name
name
f_name
specialization
Employee
phone
DOB
sex
emp_no
qualification
d
Technician
Researcher
res_ alllowance
d
Part-time
Full-time
salary
hire_date
Works_in
M
M
M
Operates
M
M
Affiliated_with
1
1
Manages
1
street
city
address
name
Hospital
phone
hsp_code
1
M
Owns
Uses
M
M
Lab
lab_no
name

The given EER diagram illustrates the logical structure of the HSP database.

According to the given description of HSP structure, the entities with corresponding attributes were created. The different types of attributes are illustrated with specific notations. Primary key attribute as an oval with underlying line (e.g emp_no), attributes which contain other attributes as composite attributes (name and address), attributes with more than one value as multivalued attributes (phone).

According to the HSP structure, employees' staff is composed of doctors, researchers, nurses and research lab technicians. Therefore, the generalization process was applied to employee and its components. The generalization process implies creating a general entity from a set of specialized entities. This way, the common features are identified and superclass, subclasses established. Subclass and Superclass relationship leads the concept of Inheritance. Thus, all the subclasses (doctor, nurse, researcher, technician) inherit properties and attributes from its superclass. Additionally, there is a disjoint constraint applied on the relationship between employee and its subclasses. Logically, an employee cannot be the doctor and nurse or nurse and researcher at the same time therefore, an entity occurrence can be a member of only one of the subclasses. The same approach was used for representing patient, inpatient and outpatient entities.

Additionally, partial and total participation of entities is specified. For example, patient entity has total participation for in and outpatients, as no patient can exist if it's not either outpatient or inpatient. The relationship between doctor who manages the department includes both partial and total participations. Not all doctors manage departments, however all the departments are managed by one of the doctors. All the illustrated relationships were analyzed and respective participations assigned.

The diagram consists of binary and ternary relationships with assigned cardinalities. For example, the binary 1:M relationship – inpatient can be assigned to only one room, while the room can host many inpatients. The ternary 1:M:M relationship - a nurse and doctor can work in only one department, while the department can have many employees associated.

Besides, the structure of HSP was upgraded by adding more attributes to the existing entities and creating new entities (medicine, surgery, research_activity). For example, the doctor prescribes medicine to an outpatient. The details of the medicine are stored independently, which conforms with good database principles and normalization rules.

Note: The detailed description of the applied normalization process is in the schema.pdf file.