GROUP-12

Project Title: Hospital Management System

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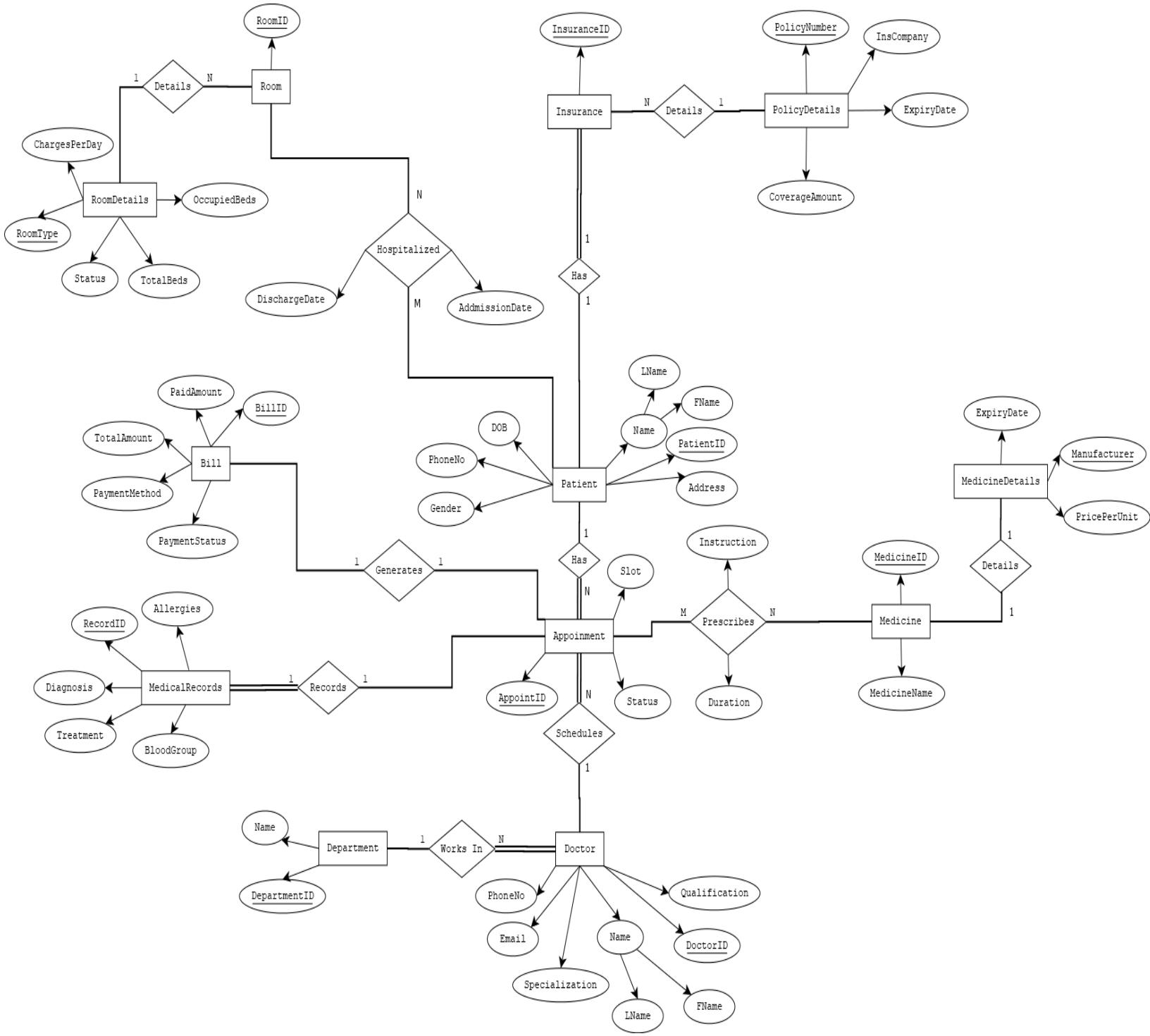
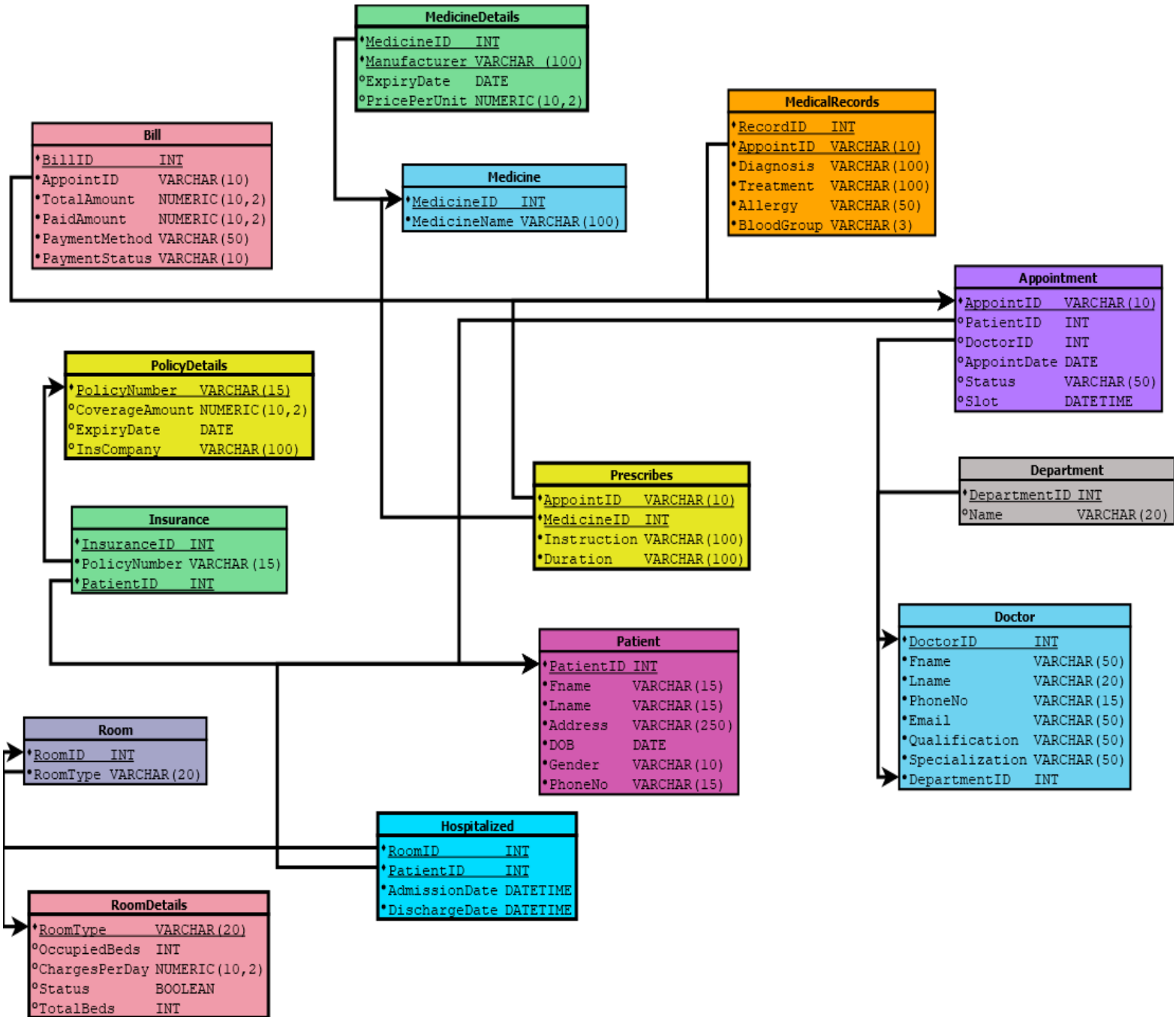
• ER-Diagram(Final):



• Relational Schema(Final):



● Minimal FDs:

1)Doctor

DoctorID -> Departmentid
DoctorID -> FName
DoctorID -> LName
DoctorID -> PhoneNo
DoctorID -> Email
DoctorID -> Qualification
DoctorID -> Specialization

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2)Department

DepartmentID -> Name

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3)Patient

PatientID -> FName
PatientID -> LName
PatientID -> Address
PatientID -> DOB
PatientID ->Gender
PatientID -> PhoneNo

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4)Appointment

AppointID -> PatientID
AppointID -> DoctorID
AppointID -> AppointDate
AppointID -> Status
AppointID -> Slot

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5)Prescribes

{MedicineID, AppointID} -> Instruction

{MedicineID, AppointID} -> Duration

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6)Medicine

MedicineID -> MedicineName

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7)MedicineDetails

{MedicieneID, Manufacturer} -> ExpiryDate

{MedicieneID, Manufacturer} -> PricePerUnit

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8)Hospitalized

{PatientID, RoomID} -> AdmissionDate

{PatientID, RoomID} -> DischargeDate

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9)Room

RoomID -> RoomType

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10)RoomDetails

RoomType ->OccupiedBeds

RoomType -> Totalbeds

RoomType -> ChargesPerDay

RoomType -> Status

---

11)Bill

BillID -> AppointID

BillID -> TotalAmount

BillID -> PaidAmount

BillID -> PaymentMethod
BillID -> PayStatus

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12)Insurance
InsuranceID -> PolicyNumber
InsuranceID -> PatientID

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13)PolicyDetails
PolicyNumber -> CoverageAmount
PolicyNumber -> ExpiryDate
PolicyNumber -> InsCompany

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14)Medical Records
RecordID -> AppointID
RecordID -> Diagnosis
RecordID -> Treatment
RecordID -> Allergy
RecordID -> BloodGroup

- **Proof of BCNF Relations:**

1)Doctor
Given FDs :
DoctorID -> DepartmentID
DoctorID -> FName
DoctorID -> LName
DoctorID -> PhoneNo
DoctorID -> Email
DoctorID -> Qualification
DoctorID -> Specialization
Closure and Candidate Key:

DoctorID$^+$ = {DoctorID, DepartmentID, FName, LName, PhoneNo, Email, Qualification, Specialization}.

All FDs have DoctorID on the left-hand side. DoctorID is the only candidate key, and hence a superkey. Every FD has a superkey on the LHS.
Therefore, the relation is in BCNF.

2)Department

Here ,
DepartmentID -> Name
Therefore , there is only FD which is in the BCNF form.
Therefore, the relation is in BCNF.

3)Patient

Given FDs:
PatientID -> FName
PatientID -> LName
PatientID -> Address
PatientID -> DOB
PatientID ->Gender
PatientID -> PhoneNo

Closure and Candidate Key:
PatientID$^+$ = {PatientID, FName, LName, Address, DOB, Gender, PhoneNo}.

All FDs have PatientID on the left-hand side. PatientID is the only candidate key, and hence a superkey. Every FD has a superkey on the LHS.
Therefore, the relation is in BCNF.

4)Appointment

Given FDs:
AppointID -> PatientID
AppointID -> DoctorID
AppointID -> AppointDate
AppointID -> Status

AppointID -> Slot

Closure and Candidate Key:
$AppointID^+$ = {AppointID, PatientID, DoctorID, AppointDate, Status, Slot}.

All FDs have AppointID on the left-hand side. AppointID is the only candidate key, and hence a superkey. Every FD has a superkey on the LHS.
Therefore, the relation is in BCNF.

5)Prescribes

Given FDs:
{MedicineID, AppointID} -> Instruction
{MedicineID, AppointID} -> Duration

Closure and Candidate Key:
$\{MedicineID, AppointID\}^+$ = {MedicineID, AppointID, Instruction, Duration}

All FDs have {MedicineID, AppointID} on the left-hand side.
{MedicineID, AppointID} is the only candidate key, hence superkey.Every FD has a superkey on the LHS.
Therefore, the relation is in BCNF.

6) Medicine

Original FDs:
MedicineID -> MedicineName
{MedicieName, Manufacturer} -> ExpiryDate
{MedicieName, Manufacturer} -> PricePerUnit

Closure and Decomposition:
$\{MedicineID, Manufacturer\}^+$ Contains all attributes of Medicine Relation.
So the key is {MedicineID, Manufacturer}.
For BCNF all left side attributes is has to be key, but in original FDs
MedicineID-> MedicineName violates the BCNF property.
So now performing BCNF decomposition on FD:

MedicineID-> MedicineName
{MedicineID}+ = {MedicineID, MedicineName}

Resulting relation :
S1 = (MedicineID, MedicineName)
For S1 key is MedicineID.
FDs for S1 is MedicineID -> MedicineName
Here S1 is Medicine Relation (Table).
Hence , follows BCNF.

The Other relation:
Let MedicineID = X.
S2 = (S - X+) ∪ X
Let S = {MedicineID, MedicineName, Manufacturer, ExpiryDate, PricePerUnit}
= (S − {MedicineID, MedicineName}) ∪ {MedicineID}
= {Manufacturer, ExpiryDate, PricePerUnit, MedicineID}
S2 = (MedicineID, Manufacturer, ExpiryDate, PricePerUnit)
For S2, FDs are the following:
{MedicineID, Manufacturer} -> ExpiryDate
{MedicineID, Manufacturer} -> PricePerUnit
Here the Key of S2 is {MedicineID, Manufacturer} Satisfies BCNF.
Here S2 is MedicineDetails Relation (Table).
Therefore , Medicine and MedicineDetails are in BCNF.

7)Hospitalized
Given FDs:
{PatientID, RoomID} -> AdmissionDate
{PatientID, RoomID} -> DischargeDate

Closure and Candidate Key:
$\{PatientID, RoomID\}^+$ = {PatientID, RoomID, AdmissionDate, DischargeDate}.

All FDs have {PatientID, RoomID} on the left-hand side.

{PatientID, RoomID} is the candidate key, therefore a superkey. Every FD has a superkey on the LHS.
Therefore, the relation is in BCNF.

8)Room

Original FDs:

RoomID -> RoomType
RoomType ->Occupancy
RoomType -> ChargesPerDay
RoomType -> Status

Closure and Decomposition:

$RoomID^+$ = All attributes
So key is RoomID
But RoomType -> OccupiedBeds violates BCNF since RoomType is not a key.
BCNF Decomposition on FD:
RoomType -> OccupiedBeds.
$RoomType^+$ = {RoomType, OccupiedBeds, TotalBeds , ChargesPerDay, Status}

This gives one relation:
S1 = (RoomType, OccupiedBeds, TotalBeds, ChargesPerDay, Status)
RoomType is key - BCNF satisfied
Here S1 is RoomDetails Relation (Table).
S2 = (Room's All Attributes - $RoomType^+$) ∪ RoomType
= (RoomID, RoomType)
FD: RoomID -> RoomType.
RoomID is key - BCNF satisfied.
Here S2 is Room Relation (Table).
So both Room and RoomDetails are in BCNF.

9)Bill

Given FDs:

BillID -> AppointID
BillID -> TotalAmount

BillID -> PaidAmount
BillID -> PaymentMethod
BillID -> PayStatus
AppointID -> BillID

Closure and Candidate Keys:
$BillID^+$ = {BillID, AppointID, TotalAmount, PaidAmount, PaymentMethod, PayStatus}.
$AppointID^+$ = {AppointID, BillID, TotalAmount, PaidAmount, PaymentMethod, PayStatus}.
Since BillID and AppointID both determine all attributes, they are candidate keys.

All FDs have either BillID or AppointID on the left-hand side.
Therefore, the relation is in BCNF.

10)Insurance
Original FDs:
InsuranceID -> PolicyNumber
InsuranceID -> PatientID
PolicyNumber -> CoverageAmount
PolicyNumber -> ExpiryDate
PolicyNumber -> InsCompany
PatientID -> InsuranceID

Closure and Decomposition:
$InsuranceID^+$ = { All attributes } So key is InsuranceID
Also, PatientID -> InsuranceID So PatientID is also a key
But FDs with PolicyNumber on LHS violate BCNF, since PolicyNumber is not a key.
BCNF Decomposition on FD:
PolicyNumber -> {CoverageAmount, ExpiryDate, InsCompany}
$PolicyNumber^+$ = {PolicyNumber, CoverageAmount, ExpiryDate, InsCompany}
So, new relation:
S1 = (PolicyNumber, CoverageAmount, ExpiryDate, InsCompany)
PolicyNumber is key - BCNF satisfied.

Here S1 is PolicyDetails Relation (Table).

Remaining Relations:
S2 = (Insurance's All Attributes -PolicyNumber$^+$) ∪ PolicyNumber
S2 = (InsuranceID, PatientID, PolicyNumber)
keys = InsuranceID / PatientID.
Hence the FDs are
InsuranceID -> PolicyNumber
InsuranceID -> PatientID
PatientID -> InsuranceID
All FDs in S2 have LHS as key - BCNF satisfied
Here S2 is Insurance Relation (Table).
Therefore, the PolicyDetails and Insurance are in BCNF.

11)Medical Records
Given FDs:
RecordID -> AppointID
RecordID -> Diagnosis
RecordID -> Treatment
RecordID -> Allergy
RecordID -> BloodGroup
AppointID -> RecordID

Observations:
RecordID -> AppointID
AppointID -> RecordID
Since we have mutual dependency,
RecordID <-> AppointID
It means that RecordID determines AppointID and AppointID determines RecordID. Therefore, RecordID and AppointID are interchangeable.

Closure and Candidate Keys:
RecordID$^+$ = {RecordID, AppointID, Diagnosis, Treatment, Allergy, BloodGroup}
Candidate Key = RecordID

AppointID^{+} = {AppointID, RecordID, Diagnosis, Treatment, Allergy, BloodGroup}
So AppointID also determines all attributes
Candidate Key = AppointID as well.

Since all functional dependencies have either RecordID or AppointID on the left-hand side, and both are candidate keys, every FD has a superkey on the LHS. Therefore, the relation is in BCNF.