N&N Hospital is facing problems in its data organization. As database analyst, you have to normalize following N&N Hospital data up to **4NF**. Elaborate each step you perform with logic and state clearly any other **VALID** assumption that you make.

+													
Doc	Name	Address	Phone	Department	Designation	Charges	Patient	Patient	CNIC	Phone	Room	Room	Bed
no.				ld		Per hour	No.	Name			No.	Type	No.
D1	Dr.Nadeem	Abc 123	0333-123,	Neurology	Professor	5000	P1	Kahlid	12345-1	042-1	R2	Normal	B1
			042-123				P5	Ahmed	12345-2	042-2	1		
							P7	<u>Anum</u>	12345-3	042-3	Nill		Nill
D2	Dr.Nadeem	Kb13	0334-124,	Orthopedic	Professor	5000	P4	Mehmood	12345-4	042-4	R2	Normal	B1
			0300-123				P7	<u>Anum</u>	12345-3	042-3	R4	Two	B5
							P9	Khawar	12345-6	042-5	1	bed	B7
D4	Dr.Erum	Ak123	0321-123	ENT/	Astt.	3000	P10	Tanweer	12345-7	042-6	Nill		Nill
				Neurology	Professor		P1	Khalid	12345-1	042-1	R5	Special	B8
D5	Dr.Hafeez	Nd123	0321-124	Skin/	Astt.	3000	P12	Sohail	12345-9	042-8	Nill		Nill
				Orthopedic	Professor		P13	Ahmed	12346-0	042-9	R6	Special	B9

1NF(1st normalization)

Here we need to maintain the atomicity of the cells. So we need to remove multivalues from the cells. And make a new entry for those values.

Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer	Abc123 Abc123 Abc123 Abc123 Abc123 kb13	0333-123	Neurology Neurology Neurology Neurology Neurology	Professor Professor Professor Professor	5000 5000 5000 5000 5000	p5 p7 p1	Khalid Ahmed Anum Khalid Ahmed	12345-1 12345-2 12345-3 12345-1	042-1 042-2 042-3 042-1	R2 R2 Nil R2	Normal Normal Nil Normal	B1 B2 Nil B1
Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer	Abc123 Abc123 Abc123 Abc123 kb13	0333-123 042-123 042-123 042-123	Neurology Neurology Neurology Neurology	Professor Professor Professor	5000 5000 5000	p7 p1	Anum Khalid	12345-3 12345-1	042-3 042-1	Nil R2	Nil	Nil
Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer	Abc123 Abc123 Abc123 kb13	042-123 042-123 042-123	Neurology Neurology Neurology	Professor Professor	5000 5000	p1	Khalid	12345-1	042-1	R2		
Or.Nadeer Or.Nadeer Or.Nadeer Or.Nadeer	Abc123 Abc123 kb13	042-123 042-123	Neurology Neurology	Professor	5000	•					Normal	B1
Or.Nadeer Or.Nadeer Or.Nadeer	Abc123 kb13	042-123	Neurology			p5	Ahmed					
Or.Nadeer Or.Nadeer	kb13			Professor	EOOO			12345-2	042-2	R2	Normal	B2
r.Nadeer		0334-124	Orthonodi		5000	p7	Anum	12345-3	042-3	Nil	Nil	Nil
	kh13		Orthopeal	Professor	5000	p4	Mehmood	12345-4	042-4	<u>R2</u>	Normal	B1
	11020	0334-124	Orthopedi	Professor	5000	p7	Anum	12345-3	042-3	R4	Two	B5
r.Nadeer	kb13	0334-124	Orthopedi	Professor	5000	p9	Khawar	12345-6	042-5	R4	Two	B7
r.Nadeer	kb13	0300-123	Orthopedi	Professor	5000	p4	Mehmood	12345-4	042-4	R2	Normal	B1
r.Nadeer	kb13	0300-123	Orthopedi	Professor	5000	p7	Anum	12345-3	042-3	R4	Two	B5
r.Nadeer	kb13	0300-123	Orthopedi	Professor	5000	p9	Khawar	12345-6	042-5	R4	Two	B7
R.erum	Ak123	0321-123	ENT	Ast.Proff	3000	p10	p11	12345-7	042-6	Nil	Nil	Nil
R.erum	Ak123	0321-123	ENT	Ast.Proff	3000	p1	Khalid	12345-1	042-1	R5	Special	B8
r.erum	Ak123	0321-123	Neurology	Ast.Proff	3000	p10	p11	12345-7	042-6	Nil	Nil	Nil
r.erum	Ak123	0321-123	Neurology	Ast.Proff	3000	p1	Khalid	12345-1	042-1	R5	Special	B8
)r.hafeez	Nd123	0321-124	Skin	Ast.Proff	3000	p12	Sohail	12345-9	042-8	Nil	Nil	Nil
)r.hafeez	Nd123	0321-124	Skin	Ast.Proff	3000	p13	Ahmed	12345-0	042-9	R6	Special	B9
r.hafeez	Nd123	0321-124	Orthopedi	Ast.Proff	3000	p12	Sohail	12345-9	042-8	Nil	Nil	Nil
)r.hafeez	Nd123	0321-124	Orthopedi	Ast.Proff	3000	p13	Ahmed	12345-0	042-9	R6	Special	B9
Or Or Or Or Or	r.Nadeer r.Nadeer r.Nadeer R.erum R.erum r.erum r.erum r.hafeez r.hafeez	r.Nadeer kb13 r.Nadeer kb13 r.Nadeer kb13 R.erum Ak123 R.erum Ak123 r.erum Ak123	r.Nadeer kb13 0300-123 r.Nadeer kb13 0300-123 r.Nadeer kb13 0300-123 r.Nadeer kb13 0301-123 R.erum Ak123 0321-123 r.erum Ak123 0321-123 r.erum Ak123 0321-123 r.hafeez Nd123 0321-124 r.hafeez Nd123 0321-124	r. Nadeer kb13 0300-123 Orthopedi r. Nadeer kb13 0300-123 Orthopedi r. Nadeer kb13 0300-123 Orthopedi r. Nadeer kb13 0321-123 ENT R. erum Ak123 0321-123 ENT r. erum Ak123 0321-123 Neurology r. erum Ak123 0321-123 Neurology r. hafeez Nd123 0321-124 Skin r. hafeez Nd123 0321-124 Orthopedi	r. Nadeer kb13 0300-123 Orthopedic Professor r. Nadeer kb13 0300-123 Orthopedic Professor r. Nadeer kb13 0300-123 Orthopedic Professor r. Nadeer kb13 0321-123 ENT Ast. Proff R. erum Ak123 0321-123 ENT Ast. Proff r. erum Ak123 0321-123 Neurology Ast. Proff r. erum Ak123 0321-123 Neurology Ast. Proff r. hafeez Nd123 0321-124 Skin Ast. Proff r. hafeez Nd123 0321-124 Skin Ast. Proff r. hafeez Nd123 0321-124 Orthopedic Ast. Proff	r. Nadeer kb13 0300-123 Orthopedic Professor 5000 r. Nadeer kb13 0300-123 Orthopedic Professor 5000 r. Nadeer kb13 0300-123 Orthopedic Professor 5000 R. erum Ak123 0321-123 ENT Ast. Proff 3000 R. erum Ak123 0321-123 ENT Ast. Proff 3000 r. erum Ak123 0321-123 Neurology Ast. Proff 3000 r. erum Ak123 0321-124 Neurology Ast. Proff 3000 r. hafeez Nd123 0321-124 Skin Ast. Proff 3000 r. hafeez Nd123 0321-124 Orthopedic Ast. Proff 3000	r.Nadeer kb13 0300-123 Orthopedic Professor 5000 p4 r.Nadeer kb13 0300-123 Orthopedic Professor 5000 p7 r.Nadeer kb13 0300-123 Orthopedic Professor 5000 p7 r.Nadeer kb13 0300-123 Orthopedic Professor 5000 p9 R.erum Ak123 0321-123 ENT Ast.Proff 3000 p10 R.erum Ak123 0321-123 ENT Ast.Proff 3000 p1 r.erum Ak123 0321-123 Neurology Ast.Proff 3000 p10 r.erum Ak123 0321-124 Neurology Ast.Proff 3000 p1 r.hafeez Nd123 0321-124 Skin Ast.Proff 3000 p12 r.hafeez Nd123 0321-124 Skin Ast.Proff 3000 p13 r.hafeez Nd123 0321-124 Orthopedic Ast.Proff 3000 p12	r. Nadeer kb13 0300-123 Orthopedil Professor 5000 p4 Mehmood r. Nadeer kb13 0300-123 Orthopedil Professor 5000 p7 Anum r. Nadeer kb13 0300-123 Orthopedil Professor 5000 p9 Khawar r. Nadeer kb13 0301-123 ENT Ast. Proff 3000 p10 p11 R. erum Ak123 0321-123 ENT Ast. Proff 3000 p1 Khalid r. erum Ak123 0321-123 Neurology Ast. Proff 3000 p1 p1 Khalid r. hafeez Nd123 0321-124 Skin Ast. Proff 3000 p1 Sohail r. hafeez Nd123 0321-124 Skin Ast. Proff 3000 p13 Ahmed r. hafeez Nd123 0321-124 Orthopedil Ast. Proff 3000 p12 Sohail	r. Nadeer kb13 0300-123 Orthopedil Professor 5000 p4 Mehmood 12345-4 r. Nadeer kb13 0300-123 Orthopedil Professor 5000 p7 Anum 12345-3 r. Nadeer kb13 0300-123 Orthopedil Professor 5000 p9 Khawar 12345-6 R. erum Ak123 0321-123 ENT Ast. Proff 3000 p10 p11 12345-7 R. erum Ak123 0321-123 ENT Ast. Proff 3000 p1 Khalid 12345-1 r. erum Ak123 0321-123 Neurology Ast. Proff 3000 p1 p1 12345-7 r. erum Ak123 0321-123 Neurology Ast. Proff 3000 p1 Khalid 12345-1 r. hafeez Nd123 0321-124 Skin Ast. Proff 3000 p1 Sohail 12345-9 r. hafeez Nd123 0321-124 Orthopedil Ast. Proff 3000 p12 Sohail 12345-9	r. Nadeer kb13 0300-123 Orthopedii Professor 5000 p4 Mehmood 12345-4 042-4 r. Nadeer kb13 0300-123 Orthopedii Professor 5000 p7 Anum 12345-3 042-3 r. Nadeer kb13 0300-123 Orthopedii Professor 5000 p9 Khawar 12345-6 042-5 R. erum Ak123 0321-123 ENT Ast. Proff 3000 p10 p11 12345-7 042-6 R. erum Ak123 0321-123 Neurology Ast. Proff 3000 p1 Khalid 12345-1 042-1 r. erum Ak123 0321-123 Neurology Ast. Proff 3000 p1 Khalid 12345-7 042-6 r. hafeez Nd123 0321-124 Skin Ast. Proff 3000 p1 Khalid 12345-1 042-1 r. hafeez Nd123 0321-124 Skin Ast. Proff 3000 p12 Sohail 12345-0 042-9 r. hafeez Nd123 0321-124 Orthopedii Ast. Proff 3000 p12 Sohail 12345-0 042-9	r.Nadeer kb13 0300-123 Orthopedil Professor 5000 p4 Mehmood 12345-4 042-4 R2 r.Nadeer kb13 0300-123 Orthopedil Professor 5000 p7 Anum 12345-3 042-3 R4 r.Nadeer kb13 0300-123 Orthopedil Professor 5000 p9 Khawar 12345-6 042-5 R4 R.erum Ak123 0321-123 ENT Ast.Proff 3000 p10 p11 12345-7 042-6 Nil R.erum Ak123 0321-123 Neurology Ast.Proff 3000 p1 p1 12345-7 042-6 Nil r.erum Ak123 0321-123 Neurology Ast.Proff 3000 p1 p1 12345-7 042-6 Nil r.hafeez Nd123 0321-124 Skin Ast.Proff 3000 p1 Sohail 12345-9 042-8 Nil r.hafeez Nd123 0321-124 Skin Ast.Proff 3000 p12 Sohail 12345-0 042-9 R6 r.hafeez Nd123 0321-124 Orthopedil Ast.Proff 3000 p12	T.Nadeer kb13 0300-123 Orthopedi Professor 5000 p4 Mehmood 12345-4 042-4 R2 Normal 7.Nadeer kb13 0300-123 Orthopedi Professor 5000 p7 Anum 12345-3 042-3 R4 Two 7.Nadeer kb13 0300-123 Orthopedi Professor 5000 p9 Khawar 12345-6 042-5 R4 Two 7.Nadeer kb13 0321-123 ENT Ast.Proff 3000 p10 p11 12345-7 042-6 Nil Nil R.erum Ak123 0321-123 ENT Ast.Proff 3000 p1 Khalid 12345-1 042-1 R5 Special 7.erum Ak123 0321-123 Neurology Ast.Proff 3000 p10 p11 12345-7 042-6 Nil Nil R.erum Ak123 0321-123 Neurology Ast.Proff 3000 p10 p11 12345-7 042-6 Nil Nil 7.erum Ak123 0321-123 Neurology Ast.Proff 3000 p1 Khalid 12345-1 042-1 R5 Special 7.hafeez Nd123 0321-124 Skin Ast.Proff 3000 p12 Sohail 12345-9 042-8 Nil Nil 7.hafeez Nd123 0321-124 Skin Ast.Proff 3000 p13 Ahmed 12345-0 042-9 R6 Special 7.hafeez Nd123 0321-124 Orthopedi Ast.Proff 3000 p12 Sohail 12345-9 042-8 Nil Nil

Here we need to remove the partial dependencies that exist between the relation.

After normalizing our table looks like.

Here our candidate key is (patient-no,department,doct-no,phone-no)

Patient name, cnic, phone is only dependent on patient no so made new table

Dname, Dname, Charges, Address, Desination is only dependent on Dno.

patient l	lc patient na	CNIC	Phone	Dno	patientNo	RoomNo	Roomtyp	e Bedno	Dno	Dname	Charges	Address	Designation	n
1	Khalid	12345-1	042-1	D1	P1	R2	Normal	B1	D1	Dr.Nadeer	5000	abc123	Professor	
) 4	Mehmood	12345-4	042-4	D1	P5	R2	Normal	B1	D2	Dr.Nadeer	5000	kb13	Professor	
p5	Ahmed	12345-2	042-2	D1	P7	nil	Nil	Nil	D4	Dr.Erum	3000	ak123	Asst.Proffe	esso
p7	Anum	12345-3	042-3	D2	P4	R2	Normal	B1	D5	Dr.Hafeez	3000	nd123	Asst.Proffe	esso
p9	Khawar	12345-6	042-5	D2	P7	R4	TwoBed	B5						
p 1 0	Tanweer	12345-7	042-6	D2	Р9	R4	TwoBed	B7						
p12	Sohail	12345-9	042-8	D4	P10	Nil	Nil	Nil						
p13	Ahmed	12345-0	042-9	D4	P1	R5	Special	B8						
				D5	P12	Nil	Nil	Nil						
				D5	R6	R6	Special	B9						
		tientTable												
D.no			PatientNo											
D1	0333-123													
D1	042-123													
D1	0333-123	Neurology	/ P5											
D1	042-123	Neurology	/ P5											
D1	0333-123	Neurology	P7											
D1	042-123	Neurology	P7											
D2	0334-124	Orthopedi	P4											
D2	0333-124	Orthopedi	P7											
D2	0333-124	Orthopedi	P9											
D2	0300-123	Orthopedi	P4											
D2	0300-123	Orthopedi	P7											
D2	0300-123	Orthopedi	P9											
D4	0321-123	ENT	p10											
D4	0321-123	ENT	p1											
D4	0321-123	Neurology	p10											
D4	0321-123													
D5	0321-124		p12											
D5	0321-124	Skin	p13											
D5	0321-124													
	2224 424		10											

3NF in 3nf we need to remove transitive dependency. After normalizing our table looks like

					3NF								
Dno	Dname	Address	Designat	ion		Designation	Charges	Dno	PatientNo	RoomNo	BedNo	RoomNO	RoomType
D1	Dr.Nadee	r abc123	Professo	r		Professor	5000	D1	P1	R2	B1	R2	Normal
D2	Dr.Nadee	r kb13	Professo	r		Asst.Profe	3000	D1	P5	R2	B1	R4	TwoBed
D3	Dr.Erum ak123		Asst.Professor				D1	P7	nil	Nil	R5	Special	
D4	Dr.Hafeez	nd123	Asst.Prof	essor				D2	P4	R2	B1	R6	Special
								D2	P7	R4	B5		
								D2	P9	R4	B7		
								D4	P10	Nil	Nil		
								D4	P1	R5	B8		
								D5	P12	Nil	Nil		
								D5	R6	R6	B9		
					Doctor-Pa	tientTable							
				D.no	PhoneNO	Departme	PatientNo						
	patient ta	ble		D1	0333-123	Neurology	P1			Doctor pl	none		
patient	: Nc patient n	a CNIC	Phone	D1		Neurology				Dno	PhoneNo		
p 1	Khalid	12345-1	042-1	D1	0333-123	Neurology				D1	0333-123		
p 4	Mehmood		042-4	D1	042-123	Neurology				D1	042-123		
5	Ahmed	12345-2	042-2	D1		Neurology				D2	034-123		
57	Anum	12345-3	042-3	D1		Neurology				D2	0300-123		
9	Khawar	12345-6	042-5	D2		Orthopedi				D4	0321-123		
10	Tanweer	12345-7	042-6	D2		Orthopedi				D5	0321-124		
p12	Sohail	12345-9	042-8	D2		Orthopedi							
p 1 3	Ahmed	12345-0	042-9	D2	0300-123	Orthopedi	P4						
				D2		Orthopedi							
				D2	0300-123	Orthopedi	P9						
				D4	0321-123		p10						
				D4	0321-123	ENT	p1						
				D4	0321-123	Neurology	p10						
				D4	0321-123	Neurology	p1						
				D5	0321-124	Skin	p12						
				D5	0321-124	Skin	p13						
				D5	0321-124	Orthopedi	p12						
				D5	0321-124	Orthopedi	p13						