

# Final Project Report

## Healthcare Management System

Database Management Systems (CSN-351)

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## Entities and Attributes

1. **Patient**: p\_id, p\_name, image, p\_contact, p\_email\_id, p\_gender, dob, timezone, blood\_group, language, password, addr\_id
2. **Doctor**: d\_id, d\_name, addr\_id, d\_gender, year\_exp, about\_me, profile\_photo, d\_contact, d\_email\_id, council\_reg\_no, council\_name, id\_proof
3. **Clinic**: c\_id, c\_contact, c\_email\_id, logo, c\_name, about, payment\_mode, ownership\_doc, addr\_id, clinic\_photo, no\_of\_beds, owner\_id
4. **Address**: addr\_id, latitude, longitude, area, colony, city, state, country, pincode
5. **Lab**: l\_id, l\_name, addr\_id, facilities
6. **Lab\_timing**: l\_id, day, start\_time, end\_time
7. **clinic\_timing**: c\_id, day, start\_time, end\_time
8. **Doctor\_timing**: d\_id, c\_id, day, slot, availability, d\_fee
9. **Test**: t\_id, test\_name, test\_price
10. **Education**: q\_id, degree, college, comp\_year, q\_proof
11. **Article**: a\_id, d\_id, at\_stamp, text, a\_image
12. **Feedback\_d**: d\_f\_id, p\_id, d\_id, d\_ft\_stamp, d\_feed\_content, d\_votes
13. **Feedback\_c**: c\_f\_id, p\_id, c\_id, c\_ft\_stamp, c\_feed\_content, c\_votes
14. **Specialization**: d\_id, spec\_name
15. **Services**: serv\_id, serv\_name
16. **P\_order**: o\_id, p\_id, total\_price, timestamp\_in, payment\_id, status, timestamp\_out
17. **Medicine**: m\_id, m\_name, m\_price, m\_avail

## Relationship and Attributes

1. **D\_appointment**: p\_id, d\_id, dt\_stamp, status
2. **L\_appointment**: p\_id, l\_id, lt\_stamp, status
3. **Consult**: p\_id, d\_id, ct\_stamp, status, problem, solution
4. **Offers**: c\_id, serv\_id
5. **Works**: d\_id, c\_id
6. **Qualification**: d\_id, q\_id
7. **Order\_content**: o\_id, m\_id, quantity, d\_p\_reg\_no

## Assumptions

1. One doctor will be associated with at most one hospital at a time and is specialized only in one field.
2. One patient can visit a particular doctor only once per day.
3. Contact No. in a single valued attribute.
4. The fee charged by the doctor is the appointment fee of that doctor. It does not consist any other chargeable fee.
5. The fee charged by the lab is the diagnosis fee of that lab. It does not consist any other chargeable fee.
6. Only patients can order the medicines.
7. A patient can only order the medicines prescribed by the registered doctors.
8. Only one contact no. per person is allowed.
9. Clinic is own by only one doctors.
10. Only one lab is present at a particular address.

## Mapping of attributes

### Patient

p_id	A
p_name	B
image	C
p_contact	D
p_email_id	E
p_gender	F
dob	G
timezone	H
blood_group	I
language	J
p_password	K
addr_id	L

### Doctor

d_id	M
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d_name	N
addr_id	L
d_gender	R <sub>3</sub>
year_exp	O
about_me	P
profile_photo	Q
d_contact	R
d_email_id	S
council_reg_no	T
council_name	U
d_password	O <sub>1</sub>

### Clinic

c_id	W
c_contact	X

c_email_id	Y
logo	Z
c_name	A <sub>1</sub>
about	B <sub>1</sub>
payment_mode	C <sub>1</sub>
ownership_doc	D <sub>1</sub>
addr_id	L
clinic_photo	E <sub>1</sub>
no_of_beds	F <sub>1</sub>
owner_id	M

#### Address

addr_id	L
area	G <sub>1</sub>
colony	H <sub>1</sub>
city	I <sub>1</sub>
state	J <sub>1</sub>
country	K <sub>1</sub>
pincode	L <sub>1</sub>
latitude	M <sub>1</sub>
longitude	N <sub>1</sub>

#### Lab

l_id	P <sub>1</sub>
l_name	Q <sub>1</sub>
addr_id	L
facilities	R <sub>1</sub>

#### Lab\_timing

l_id	P <sub>1</sub>
day	S <sub>1</sub>
start_time	T <sub>1</sub>
end_time	U <sub>1</sub>

#### Clinic\_timing

c_id	W
day	V <sub>1</sub>
start_time	W <sub>1</sub>
end_time	X <sub>1</sub>

#### Doctor\_timing

d_id	M
c_id	W
day	Y <sub>1</sub>
slot	Z <sub>1</sub>
availability	A <sub>2</sub>
d_fee	U <sub>3</sub>

#### Test

l_id	P <sub>1</sub>
test_name	B <sub>2</sub>
test_price	C <sub>2</sub>

#### Education

q_id	D <sub>2</sub>
degree	Q <sub>3</sub>
college	E <sub>2</sub>
comp_year	F <sub>2</sub>

q_proof	G <sub>2</sub>
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#### Article

a_id	H <sub>2</sub>
a_image	I <sub>2</sub>
d_id	M
text	J <sub>2</sub>
at_stamp	K <sub>2</sub>

#### Feedback\_d

d_f_id	L <sub>2</sub>
p_id	A
d_id	M
d_ft_stamp	M <sub>2</sub>
d_feed_content	N <sub>2</sub>
d_vote	O <sub>3</sub>

#### Feedback\_c

c_f_id	O <sub>2</sub>
p_id	A
c_id	W
c_ft_stamp	P <sub>2</sub>
c_feed_content	Q <sub>2</sub>
c_vote	P <sub>3</sub>

#### Specialization

d_id	M
specialization	R <sub>2</sub>

#### Services

serv_id	S <sub>2</sub>
serv_name	T <sub>2</sub>

#### P\_order

o_id	U <sub>2</sub>
p_id	A
total_price	V <sub>2</sub>
timestamp_in	W <sub>2</sub>
payment_id	X <sub>2</sub>
o_status	Y <sub>2</sub>
timestamp_out	Z <sub>2</sub>

#### Medicine

m_id	A <sub>3</sub>
m_name	B <sub>3</sub>
m_price	C <sub>3</sub>
m_avail	S <sub>3</sub>

#### D\_appointment

p_id	A
d_id	M
d_book_timestamp	M <sub>3</sub>
dt_stamp	D <sub>3</sub>
d_status	E <sub>3</sub>

#### L\_appointment

p_id	A
l_id	P <sub>1</sub>

lt_stamp	F <sub>3</sub>
l_status	G <sub>3</sub>
l_book_timestamp	N <sub>3</sub>

#### Consult

p_id	A
d_id	M
ct_stamp	H <sub>3</sub>
problem	I <sub>3</sub>
consult_status	J <sub>3</sub>
solution	K <sub>3</sub>

#### Offers

c_id	W
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serv_id	S <sub>2</sub>
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#### Works

d_id	M
c_id	W

#### Qualification

d_id	M
q_id	D <sub>2</sub>

#### Order\_content

o_id	U <sub>2</sub>
m_id	A <sub>3</sub>
quantity	L <sub>3</sub>
d_p_reg_no	T <sub>3</sub>

### Functional dependencies

#### Patient:

A	→	BCDEFGHIJKL
E	→	A
D	→	A

#### Doctor:

M	→	NLOPQRSTUO <sub>1</sub> R <sub>3</sub>
S	→	M
R	→	M
TU	→	M

#### Clinic:

W	→	XYZA <sub>1</sub> B <sub>1</sub> C <sub>1</sub> D <sub>1</sub> LE <sub>1</sub> F <sub>1</sub> M
Y	→	W
X	→	W

#### Address:

L	→	G <sub>1</sub> H <sub>1</sub> I <sub>1</sub> J <sub>1</sub> K <sub>1</sub> L <sub>1</sub> M <sub>1</sub> N <sub>1</sub>
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M <sub>1</sub> N <sub>1</sub>	→	L
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#### Lab:

P <sub>1</sub>	→	Q <sub>1</sub> LR <sub>1</sub>
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#### Lab\_timing:

P <sub>1</sub> S <sub>1</sub>	→	T <sub>1</sub> U <sub>1</sub>
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#### Clinic\_timing:

WV <sub>1</sub>	→	W <sub>1</sub> X <sub>1</sub>
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#### Doctor\_timing:

MWY <sub>1</sub> Z <sub>1</sub>	→	A <sub>2</sub> U <sub>3</sub>
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#### Test:

P <sub>1</sub> B <sub>2</sub>	→	C <sub>2</sub>
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#### Education:

$D_2 \rightarrow Q_3E_2F_2G_2$

Article:

$H_2 \rightarrow I_2MJ_2K_2$

$MK_2 \rightarrow H_2$

Feedback\_d:

$L_2 \rightarrow AMM_2N_2O_3$

$AMM_2 \rightarrow L_2$

Feedback\_c

$O_2 \rightarrow AWP_2Q_2P_3$

$AWP_2 \rightarrow O_2$

Services

$S_2 \rightarrow T_2$

Order

$U_2 \rightarrow AV_2W_2X_2Y_2Z_2$

$AW_2 \rightarrow U_2$

$X_2 \rightarrow U_2$

Medicine

$A_3 \rightarrow B_3C_3S_3$

D\_appointment

$AMM_3 \rightarrow D_3E_3$

L\_appointment

$AP_1N_3 \rightarrow F_3G_3$

Consult

$AMH_3 \rightarrow I_3J_3K_3$

Offers

$W \rightarrow S_2$

Qualification

$M \rightarrow D_2$

Order\_content

$U_2A_3 \rightarrow L_3T_3$

## Minimal Cover

Step 1: Replace each functional dependency  $X \rightarrow \{A_1, A_2, \dots, A_n\}$  in F by the n

functional dependencies  $X \rightarrow A_1, X \rightarrow A_2, \dots, X \rightarrow A_n$ .

$A \rightarrow B$

$A \rightarrow C$

$A \rightarrow D$

$A \rightarrow E$

$A \rightarrow F$

$A \rightarrow G$

$A \rightarrow H$

$A \rightarrow I$

$A \rightarrow J$

$A \rightarrow K$

$A \rightarrow L$

$E \rightarrow A$

$D \rightarrow A$

$M \rightarrow N$

$M \rightarrow L$

$M \rightarrow R_3$

$M \rightarrow O$

$M \rightarrow P$

$M \rightarrow Q$

$M \rightarrow R$

$M \rightarrow S$

$M \rightarrow T$

$M \rightarrow U$

$M \rightarrow O_1$

$S \rightarrow M$

$R \rightarrow M$

$TU \rightarrow M$

$W \rightarrow X$

$W \rightarrow Y$   
 $W \rightarrow Z$   
 $W \rightarrow A_1$   
 $W \rightarrow B_1$   
 $W \rightarrow C_1$   
 $W \rightarrow D_1$   
 $W \rightarrow L$   
 $W \rightarrow E_1$   
 $W \rightarrow F_1$   
 $W \rightarrow M$   
 $Y \rightarrow W$   
 $X \rightarrow W$   
 $L \rightarrow G_1$   
 $L \rightarrow H_1$   
 $L \rightarrow I_1$   
 $L \rightarrow J_1$   
 $L \rightarrow K_1$   
 $L \rightarrow L_1$   
 $L \rightarrow M_1$   
 $L \rightarrow N_1$   
 $M_1 N_1 \rightarrow L$   
 $P \rightarrow Q_1$   
 $P \rightarrow L$   
 $P \rightarrow R_1$   
 $P_1 S_1 \rightarrow T_1$   
 $P_1 S_1 \rightarrow U_1$   
 $WV_1 \rightarrow W_1$   
 $WV_1 \rightarrow X_1$   
 $MWY_1 Z_1 \rightarrow A_2$   
 $MWY_1 Z_1 \rightarrow U_3$   
 $P_1 B_2 \rightarrow C_2$   
 $D_2 \rightarrow Q_3$   
 $D_2 \rightarrow E_2$   
 $D_2 \rightarrow F_2$   
 $D_2 \rightarrow G_2$   
 $H_2 \rightarrow I_2$   
 $H_2 \rightarrow M$

$H_2 \rightarrow J_2$   
 $H_2 \rightarrow K_2$   
 $MK_2 \rightarrow H_2$   
 $L_2 \rightarrow A$   
 $L_2 \rightarrow M$   
 $L_2 \rightarrow M_2$   
 $L_2 \rightarrow N_2$   
 $L_2 \rightarrow O_3$   
 $AMM_2 \rightarrow L_2$   
 $O_2 \rightarrow A$   
 $O_2 \rightarrow W$   
 $O_2 \rightarrow P_2$   
 $O_2 \rightarrow Q_2$   
 $O_2 \rightarrow P_3$   
 $AWP_2 \rightarrow O_2$   
 $S_2 \rightarrow T_2$   
 $U_2 \rightarrow A$   
 $U_2 \rightarrow V_2$   
 $U_2 \rightarrow W_2$   
 $U_2 \rightarrow X_2$   
 $U_2 \rightarrow Y_2$   
 $U_2 \rightarrow Z_2$   
 $AW_2 \rightarrow U_2$   
 $X_2 \rightarrow U_2$   
 $A_3 \rightarrow B_3$   
 $A_3 \rightarrow C_3$   
 $A_3 \rightarrow S_3$   
 $AMM_3 \rightarrow D_3$   
 $AMM_3 \rightarrow E_3$   
 $AP1N_3 \rightarrow F_3$   
 $AP1N_3 \rightarrow G_3$   
 $AMH_3 \rightarrow I_3$   
 $AMH_3 \rightarrow J_3$   
 $AMH_3 \rightarrow K_3$   
 $W \rightarrow S_2$   
 $M \rightarrow D_2$   
 $U_2 A_3 \rightarrow L_3$   
 $U_2 A_3 \rightarrow T_3$

Closures:

$A^+ = \{A, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\}$   
 $E^+ = \{A, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\}$   
 $D^+ = \{A, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\}$



$$\begin{aligned}
M^+ &= \{M, N, L, O, P, Q, R, S, T, U, O_1, R_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, D_2, E_2, F_2, G_2\} \\
S^+ &= \{M, N, L, O, P, Q, R, S, T, U, O_1, R_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, D_2, E_2, F_2, G_2\} \\
R^+ &= \{M, N, L, O, P, Q, R, S, T, U, O_1, R_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, D_2, E_2, F_2, G_2\} \\
TU^+ &= \{M, N, L, O, P, Q, R, S, T, U, O_1, R_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, D_2, E_2, F_2, G_2\} \\
W^+ &= \{W, X, Y, Z, A_1, B_1, C_1, D_1, L, E_1, F_1, M, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, N, L, O, P, Q, R, S, T, U, O_1, R_3, D_2, E_2, F_2, \\
&G_2, S_2, T_2\} \\
Y^+ &= \{W, X, Y, Z, A_1, B_1, C_1, D_1, L, E_1, F_1, M, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, N, L, O, P, Q, R, S, T, U, O_1, R_3, D_2, E_2, F_2, \\
&G_2, S_2, T_2\} \\
X^+ &= \{W, X, Y, Z, A_1, B_1, C_1, D_1, L, E_1, F_1, M, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, N, L, O, P, Q, R, S, T, U, O_1, R_3, D_2, E_2, F_2, \\
&G_2, S_2, T_2\} \\
L^+ &= \{L, G_1, H_1, I_1, H_1, J_1, K_1, L_1, M_1, N_1\} \\
M_1N_1^+ &= \{L, G_1, H_1, I_1, H_1, J_1, K_1, L_1, M_1, N_1\} \\
P_1^+ &= \{P_1, Q_1, L, R_1, G_1, H_1, I_1, H_1, J_1, K_1, L_1, M_1, N_1\} \\
P_1S_1^+ &= \{P_1, S_1, T_1, U_1, Q_1, L_1, R_1, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\} \\
WV_1^+ &= \\
&\{W, V_1, W_1, X_1, S_2, T_2, X, Y, Z, A_1, B_1, C_1, D_1, L, E_1, M, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, N, L, O, P, Q, R, S, T, U, \\
&O_1, D_2, E_2, F_2, G_2, S_2, T_2, Q_3\} \\
MWY_1Z_1^+ &= \{M, W, Y_1, Z_1, A_2, U_3, N, L, O, P, Q, R, S, T, U, O_1, R_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, D_2, E_2, F_2, G_2, W, X, \\
&Y, Z, A_1, B_1, C_1, D_1, L, E_1, F_1, S_2, T_2, Q_3\} \\
P_1B_2^+ &= \{P_1, B_2, C_2, Q_1, L, R_1, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\} \\
D_2^+ &= \{D_2, E_2, F_2, G_2, Q_3\} \\
H_2^+ &= \{H_2, I_2, M, J_2, K_2, N, L, O, P, Q, R, S, T, U, O_1, R_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, D_2, Q_3, E_2, F_2, G_2\} \\
MK_2^+ &= \{H_2, I_2, M, J_2, K_2, N, L, O, P, Q, R, S, T, U, O_1, R_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, D_2, Q_3, E_2, F_2, G_2\} \\
L_2^+ &= \{L_2, A, M, M_2, N_2, O_3, N, L, O, P, Q, R, S, T, U, O_1, R_3, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, \\
&D_2, Q_3, E_2, F_2, G_2\} \\
AMM_2^+ &= \{L_2, A, M, M_2, N_2, O_3, N, L, O, P, Q, R, S, T, U, O_1, R_3, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, \\
&N_1, D_2, Q_3, E_2, F_2, G_2\} \\
O_2^+ &= \{O_2, A, W, P_2, Q_2, P_3, B, C, D, E, F, G, H, I, J, K, X, Y, Z, A_1, B_1, C_1, D_1, E_1, F_1, M, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, \\
&N, L, O, P, Q, R, S, T, U, O_1, R_3, D_2, E_2, F_2, G_2, S_2, T_2\} \\
AWP_2^+ &= \{O_2, A, W, P_2, Q_2, P_3, B, C, D, E, F, G, H, I, J, K, X, Y, Z, A_1, B_1, C_1, D_1, E_1, F_1, M, G_1, H_1, I_1, J_1, K_1, L_1, M_1, \\
&N_1, N, L, O, P, Q, R, S, T, U, O_1, R_3, D_2, E_2, F_2, G_2, S_2, T_2\} \\
S_2^+ &= \{S_2, T_2\} \\
U_2^+ &= \{U_2, A, V_2, W_2, X_2, Y_2, Z_2, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\} \\
AW_2^+ &= \{U_2, A, V_2, W_2, X_2, Y_2, Z_2, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\} \\
X_2^+ &= \{U_2, A, V_2, W_2, X_2, Y_2, Z_2, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\} \\
A_3^+ &= \{A_3, B_3, C_3, S_3\} \\
AMM_3^+ &= \{A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, M_3, D_3, E_3, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1, O_1, R_3, \\
&D_2, E_2, F_2, G_2\} \\
AP_1N_3^+ &= \{U_2, A_3, L_3, T_3, B_3, C_3, S_3, A, V_2, W_2, X_2, Y_2, Z_2, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\} \\
AMH_3^+ &= \{A, M, H_3, I_3, J_3, K_3, B, C, D, E, F, G, H, I, J, K, L, N, O, P, Q, R, S, T, U, M_3, D_3, E_3, G_1, H_1, I_1, J_1, K_1, L_1, \\
&M_1, N_1, O_1, R_3, D_2, E_2, F_2, G_2\} \\
U_2A_3^+ &= \{U_2, A_3, L_3, T_3, B_3, C_3, S_3, A, V_2, W_2, X_2, Y_2, Z_2, B, C, D, E, F, G, H, I, J, K, L, G_1, H_1, I_1, J_1, K_1, L_1, M_1, N_1\}
\end{aligned}$$

Step 2 : For each functional dependency  $X \rightarrow A$  in  $F$   
for each attribute  $B$  that is an element of  $X$   
if  $\{ \{F - \{X \rightarrow A\} \} \cup \{ (X - \{B\}) \rightarrow A \} \}$  is equivalent to  $F$   
then replace  $X \rightarrow A$  with  $(X - \{B\}) \rightarrow A$  in  $F$ .

$A \rightarrow B$   
 $A \rightarrow C$   
 $A \rightarrow D$   
 $A \rightarrow E$   
 $A \rightarrow F$   
 $A \rightarrow G$   
 $A \rightarrow H$   
 $A \rightarrow I$   
 $A \rightarrow J$   
 $A \rightarrow K$   
 $A \rightarrow L$   
 $E \rightarrow A$   
 $D \rightarrow A$   
 $M \rightarrow N$   
 $M \rightarrow L$   
 $M \rightarrow R_3$   
 $M \rightarrow O$   
 $M \rightarrow P$   
 $M \rightarrow Q$   
 $M \rightarrow R$   
 $M \rightarrow S$   
 $M \rightarrow T$   
 $M \rightarrow U$   
 $M \rightarrow O_1$   
 $S \rightarrow M$   
 $R \rightarrow M$   
 $TU \rightarrow M$   
 $W \rightarrow X$   
 $W \rightarrow Y$   
 $W \rightarrow Z$   
 $W \rightarrow A_1$   
 $W \rightarrow B_1$   
 $W \rightarrow C_1$   
 $W \rightarrow D_1$   
 $W \rightarrow L$   
 $W \rightarrow E_1$   
 $W \rightarrow F_1$   
 $W \rightarrow M$   
 $Y \rightarrow W$

$X \rightarrow W$   
 $L \rightarrow G_1$   
 $L \rightarrow H_1$   
 $L \rightarrow I_1$   
 $L \rightarrow J_1$   
 $L \rightarrow K_1$   
 $L \rightarrow L_1$   
 $L \rightarrow M_1$   
 $L \rightarrow N_1$   
 $M_1N_1 \rightarrow L$   
 $P \rightarrow Q_1$   
 $P \rightarrow L$   
 $P \rightarrow R_1$   
 $P_1S_1 \rightarrow T_1$   
 $P_1S_1 \rightarrow U_1$   
 $WV_1 \rightarrow W_1$   
 $WV_1 \rightarrow X_1$   
 $MWY_1Z_1 \rightarrow A_2$   
 $P_1B_2 \rightarrow C_2$   
 $D_2 \rightarrow Q_3$   
 $D_2 \rightarrow E_2$   
 $D_2 \rightarrow F_2$   
 $D_2 \rightarrow G_2$   
 $H_2 \rightarrow I_2$   
 $H_2 \rightarrow M$   
 $H_2 \rightarrow J_2$   
 $H_2 \rightarrow K_2$   
 $MK_2 \rightarrow H_2$   
 $L_2 \rightarrow A$   
 $L_2 \rightarrow M$   
 $L_2 \rightarrow M_2$   
 $L_2 \rightarrow N_2$   
 $L_2 \rightarrow O_3$   
 $AMM_2 \rightarrow L_2$   
 $O_2 \rightarrow A$   
 $O_2 \rightarrow W$   
 $O_2 \rightarrow P_2$   
 $O_2 \rightarrow Q_2$   
 $O_2 \rightarrow P_3$

$AWP_2 \rightarrow O_2$   
 $S_2 \rightarrow T_2$   
 $U_2 \rightarrow A$   
 $U_2 \rightarrow V_2$   
 $U_2 \rightarrow W_2$   
 $U_2 \rightarrow X_2$   
 $U_2 \rightarrow Y_2$   
 $U_2 \rightarrow Z_2$   
 $AW_2 \rightarrow U_2$   
 $X_2 \rightarrow U_2$   
 $A_3 \rightarrow B_3$   
 $A_3 \rightarrow C_3$

$A_3 \rightarrow S_3$   
 $AMM_3 \rightarrow D_3$   
 $AMM_3 \rightarrow E_3$   
 $AP1N_3 \rightarrow F_3$   
 $AP1N_3 \rightarrow G_3$   
 $AMH_3 \rightarrow I_3$   
 $AMH_3 \rightarrow J_3$   
 $AMH_3 \rightarrow K_3$   
 $W \rightarrow S_2$   
 $M \rightarrow D_2$   
 $U_2A_3 \rightarrow L_3$   
 $U_2A_3 \rightarrow T_3$

No functional dependencies removed.

Step 3 : For each remaining functional dependency  $X \rightarrow A$  in  $F$   
 if  $\{F - \{X \rightarrow A\}\}$  is equivalent to  $F$ ,  
 then remove  $X \rightarrow A$  from  $F$ .

$A \rightarrow B$   
 $A \rightarrow C$   
 $A \rightarrow D$   
 $A \rightarrow E$   
 $A \rightarrow F$   
 $A \rightarrow G$   
 $A \rightarrow H$   
 $A \rightarrow I$   
 $A \rightarrow J$   
 $A \rightarrow K$   
 $A \rightarrow L$   
 $E \rightarrow A$   
 $D \rightarrow A$   
 $M \rightarrow N$   
 $M \rightarrow L$   
 $M \rightarrow R_3$   
 $M \rightarrow O$   
 $M \rightarrow P$   
 $M \rightarrow Q$   
 $M \rightarrow R$   
 $M \rightarrow S$   
 $M \rightarrow T$   
 $M \rightarrow U$   
 $M \rightarrow O_1$   
 $S \rightarrow M$

$R \rightarrow M$   
 $TU \rightarrow M$   
 $W \rightarrow X$   
 $W \rightarrow Y$   
 $W \rightarrow Z$   
 $W \rightarrow A_1$   
 $W \rightarrow B_1$   
 $W \rightarrow C_1$   
 $W \rightarrow D_1$   
 $W \rightarrow L$   
 $W \rightarrow E_1$   
 $W \rightarrow F_1$   
 $W \rightarrow M$   
 $Y \rightarrow W$   
 $X \rightarrow W$   
 $L \rightarrow G_1$   
 $L \rightarrow H_1$   
 $L \rightarrow I_1$   
 $L \rightarrow J_1$   
 $L \rightarrow K_1$   
 $L \rightarrow L_1$   
 $L \rightarrow M_1$   
 $L \rightarrow N_1$   
 $M_1N_1 \rightarrow L$   
 $P \rightarrow Q_1$

$P \rightarrow L$   
 $P \rightarrow R_1$   
 $P_1S_1 \rightarrow T_1$   
 $P_1S_1 \rightarrow U_1$   
 $WV_1 \rightarrow W_1$   
 $WV_1 \rightarrow X_1$   
 $MWY_1Z_1 \rightarrow A_2$   
 $P_1B_2 \rightarrow C_2$   
 $D_2 \rightarrow Q_3$   
 $D_2 \rightarrow E_2$   
 $D_2 \rightarrow F_2$   
 $D_2 \rightarrow G_2$   
 $H_2 \rightarrow I_2$   
 $H_2 \rightarrow M$   
 $H_2 \rightarrow J_2$   
 $H_2 \rightarrow K_2$   
 $MK_2 \rightarrow H_2$   
 $L_2 \rightarrow A$   
 $L_2 \rightarrow M$   
 $L_2 \rightarrow M_2$   
 $L_2 \rightarrow N_2$   
 $L_2 \rightarrow O_3$   
 $AMM_2 \rightarrow L_2$   
 $O_2 \rightarrow A$   
 $O_2 \rightarrow W$   
 $O_2 \rightarrow P_2$

$O_2 \rightarrow Q_2$   
 $O_2 \rightarrow P_3$   
 $AWP_2 \rightarrow O_2$   
 $S_2 \rightarrow T_2$   
 $U_2 \rightarrow A$   
 $U_2 \rightarrow V_2$   
 $U_2 \rightarrow W_2$   
 $U_2 \rightarrow X_2$   
 $U_2 \rightarrow Y_2$   
 $U_2 \rightarrow Z_2$   
 $AW_2 \rightarrow U_2$   
 $X_2 \rightarrow U_2$   
 $A_3 \rightarrow B_3$   
 $A_3 \rightarrow C_3$   
 $A_3 \rightarrow S_3$   
 $AMM_3 \rightarrow D_3$   
 $AMM_3 \rightarrow E_3$   
 $AP1N_3 \rightarrow F_3$   
 $AP1N_3 \rightarrow G_3$   
 $AMH_3 \rightarrow I_3$   
 $AMH_3 \rightarrow J_3$   
 $AMH_3 \rightarrow K_3$   
 $W \rightarrow S_2$   
 $M \rightarrow D_2$   
 $U_2A_3 \rightarrow L_3$   
 $U_2A_3 \rightarrow T_3$

No functional dependencies removed.

Final minimal cover:

No changes in the dependencies.

## Decomposition

Patient:

Candidate Keys: A, E, D

Patient table is already in BCNF.

Doctor:

Candidate Keys: M, S, R, TU

Doctor table is already in BCNF.

Clinic:

Candidate Keys: W, Y, X

Clinic table is already in BCNF.

Address:

Candidate Keys: L, M<sub>1</sub>N<sub>1</sub>

Address table is already in BCNF.

Lab:

Candidate Keys: P<sub>1</sub>

Lab table is already in BCNF.

Lab\_timing:

Candidate Keys:  $P_1S_1$

Lab\_timing table is already in BCNF.

Clinic\_timing:

Candidate Keys:  $WV_1$

Clinic\_timing table is already in BCNF.

Doctor\_timing:

Candidate Keys:  $MWY_1Z_1$

Doctor\_timing table is already in BCNF.

Test:

Candidate Keys:  $P_1B_2$

Test table is already in BCNF.

Education:

Candidate Keys:  $D_2$

Education table is already in BCNF.

Article:

Candidate Keys:  $H_2, MK_2$

Article table is already in BCNF.

Feedback\_d:

Candidate Keys:  $L_2, AMM_2$

Feedback\_d table is already in BCNF.

Feedback\_c:

Candidate Keys:  $O_2, AWP_2$

Feedback\_c table is already in BCNF.

Services:

Candidate Keys:  $S_2$

Services table is already in BCNF.

Order:

Candidate Keys:  $U_2, AW_2, X_2$

Order table is already in BCNF.

Medicine:

Candidate Keys:  $A_3$

Medicine table is already in BCNF.

D\_appointment:

Candidate Keys:  $AMM_3$

D\_appointment table is already in BCNF.

L\_appointment:

Candidate Keys:  $AP_1N_3$

L\_appointment table is already in BCNF.

Consult:

Candidate Keys:  $AMH_3$

Consult table is already in BCNF.

Offers:

Candidate Keys:  $W$

Offers table is already in BCNF.

Qualification:

Candidate Keys:  $M$

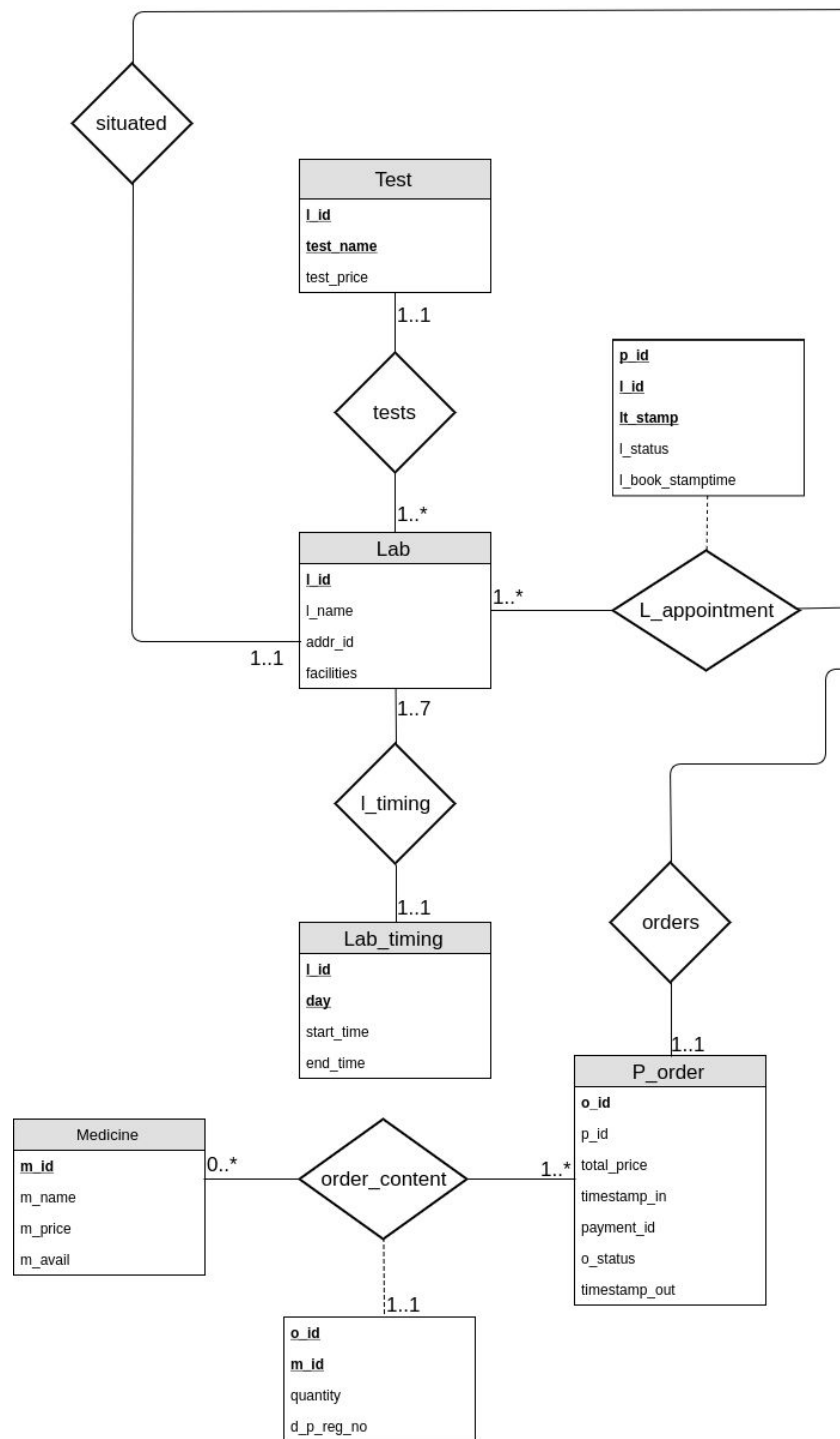
Qualification table is already in BCNF.

Order\_content:

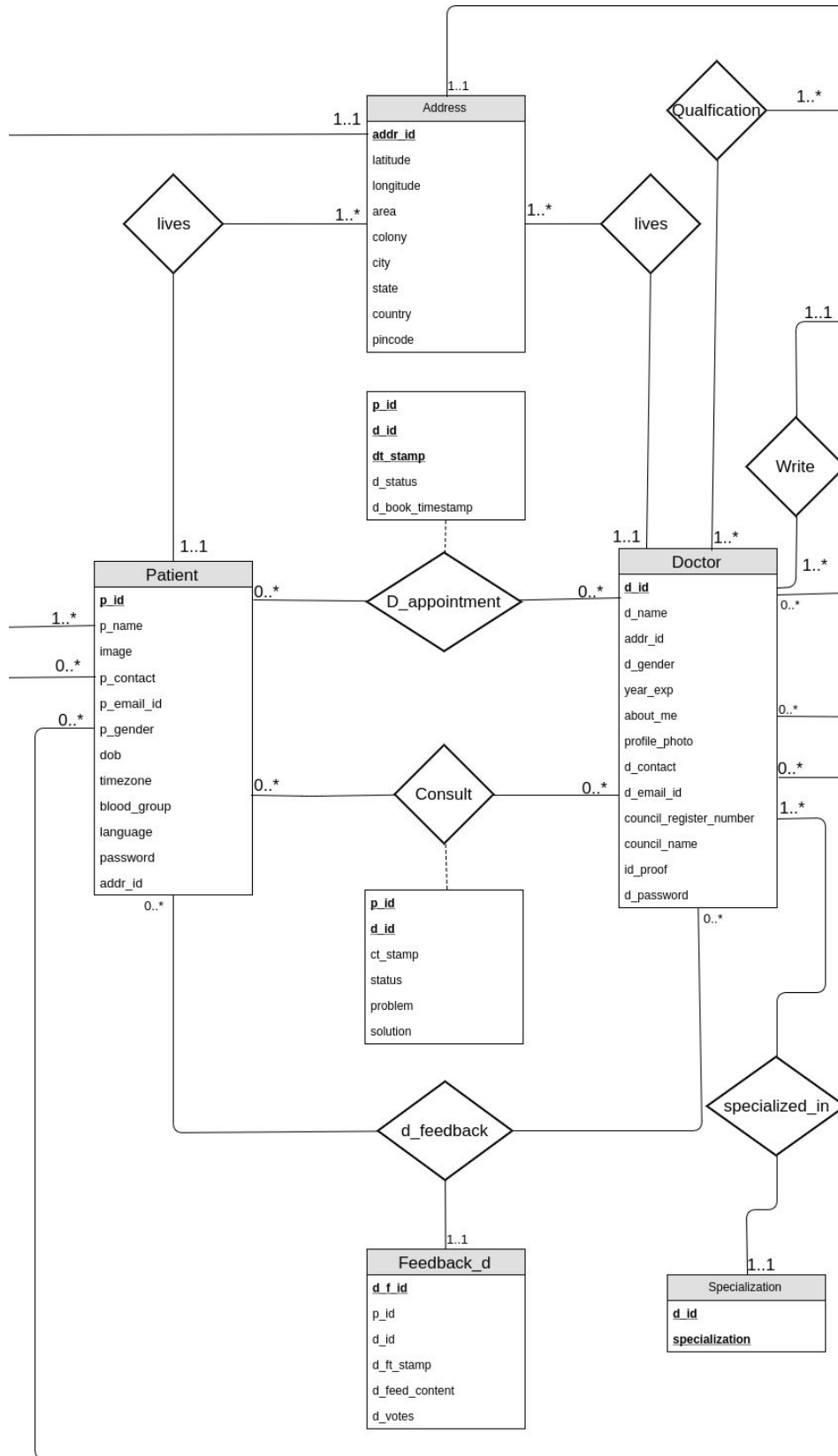
Candidate Keys:  $U_2A_3$

Order\_content table is already in BCNF.

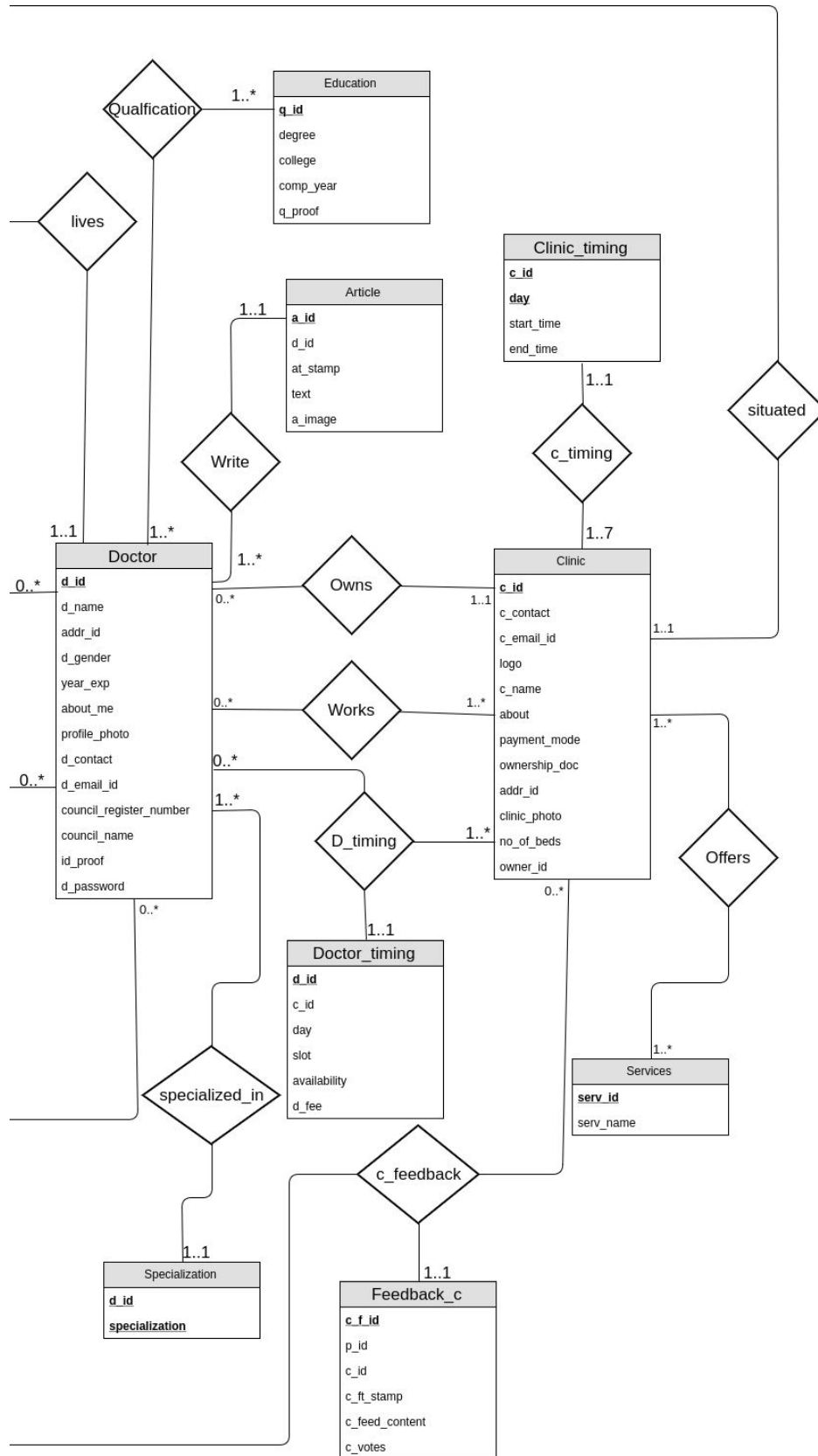
## ER Diagram



ER Diagram1

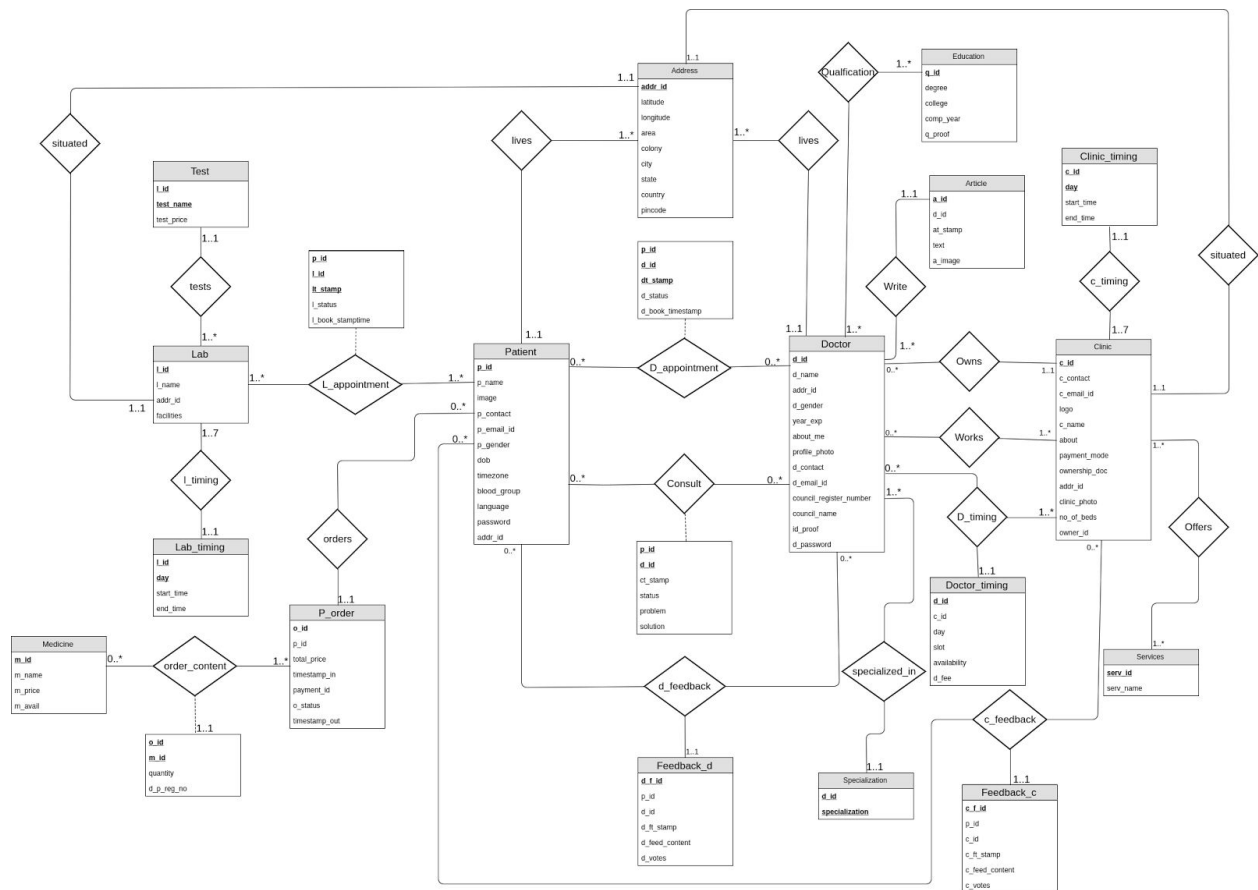


ER Diagram2



ER Diagram3





ER Diagram (combined)

## Basic Queries:

### 1. Medical History

```
select d_id, d_book_timestamp, d_status from Patient natural join D_appointment where
d_book_timestamp < NOW() and p_id = (current_user)
//Current user id will be known to us at runtime
```

```
select p_id, d_book_timestamp, d_status from Doctor natural join D_appointment where
d_book_timestamp < NOW() and d_id = (current_doctor)
//Current doctor id will be known to us at runtime
```

### 2. Appointments

```
select d_id, d_book_timestamp, d_status from Patient natural join D_appointment where
d_book_timestamp >= NOW() and p_id = (current_user)
```

//Current user id will be known to us at runtime

```
select p_id, d_book_timestamp, d_status from Doctor natural join D_appointment where  
d_book_timestamp >= NOW() and d_id = (current_doctor)
```

//Current doctor id will be known to us at runtime

### 3. Nearby Doctors

```
select d_id, d_name, addr_id, 111.111 * DEGREES(ACOS(COS(RADIANS(latitude)) *  
COS(RADIANS(curr_lat)) * COS(RADIANS(longitude - curr_long)) + SIN(RADIANS(latitude)) *  
SIN(RADIANS(curr_lat)))) as dist_km from Address natural join Doctor order by dist_km asc;
```

### 4. Doctor Search based on specialization

```
select d_id, d_name, specialization from Doctor natural join Specialization where specialization  
= 'Neurologist';
```

### 5. Doctor search based on slot and availability

```
select d_id, d_name, day, slot from Doctor natural join Doctor_timing where day =  
dayofweek(now()) and d_id = 1 and availability > 0;
```

### 6. Doctor search based on fee

```
select distinct(d_id), d_name, c_id, d_fee from Doctor natural join Doctor_timing order by  
d_fee;
```

### 7. Doctor search based on popularity

```
select d_id, d_name, sum(d_votes) as vote from Doctor natural join Feedback_d group by d_id  
order by vote desc;
```

### 8. Lab search based on test

```
select l_id, l_name, city from Lab natural join Test natural join Address where test_name = 'Eeg'  
order by test_price;
```

### 9. Clinic search based on services

```
select c_id, c_name from Clinic natural join Offers natural join Services where serv_name =  
'X-Ray';
```

### 10. Articles

```
select text, a_image, at_stamp from Article order by at_stamp desc;
```

## 11. Appointment Booking

Insert into D\_appointment (p\_id, d\_id, d\_book\_timestamp, dt\_stamp) values (curr\_p\_id, selected\_d\_id, given\_datetime, curr\_datetime);

update Doctor\_timing set availability = availability-1 where (d\_id, c\_id, day, slot) = (selected\_d\_id, selected\_c\_id, dayofweek(selected\_date), selected\_slot);