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 CSCI 2441W - Project 1
 7 March 2019

Keywords: Blood bank system, blood, database, patients, donors, blood group

Database for Blood Bank System

Our database is designed for a blood donation system. Blood banks require data for patients and donors as well as information about themselves. The data needed to keep track of each patient is his or her ID number, name, blood type group, and any diseases the patient may have. Patients are identified by their primary key which we set to be their ID number. Donors are classified by their ID numbers, names, blood type groups, addresses, medical reports, and contact numbers. Donors are also identified by their primary key which is their ID number. Additionally, the blood bank is in charge of holding data for its name (like American Red Cross Center), address, contact number, and the ID numbers of the patients and donors donating and receiving blood from them. Blood banks have the primary key of the patient ID number followed by the donor ID number. Donors and patients do not have any direct relationship with each other, as blood banks typically serve as a median communicator between the two. Therefore, the blood bank should have a total participation constraint defining its relationship with both the patient and the donor. Blood banks will always be collecting blood from donors and donating blood to patients because they have to show up *at least once* in every relation.

Databases provide an easy way for blood banks to keep track of their records and easily communicate between their constituents. They have to be able to keep track of who they are donating to and collecting from, which is represented in the schema below. Our team devised a database that holds the necessary information needed for patients, donors, and the blood bank itself. We came up with twenty different queries that address different blood groups for patients and donors, different blood bank centers, specific patients, and diseases they could have. Following these queries is the relational algebra, tuple relational calculus, and domain relational calculus solutions to find the answers to our queries.

The **schema** is as follows...

Patient (pid: integer, p_name: string, p_bgroup: string, p_disease: string)

Donor (did: integer, d_name: string, d_bgroup: string, med_report: string, d_address: string, d_num: string)

Blood Bank (pid: integer, did: integer, b_name: string, b_address: string, b_num: string)

ERD

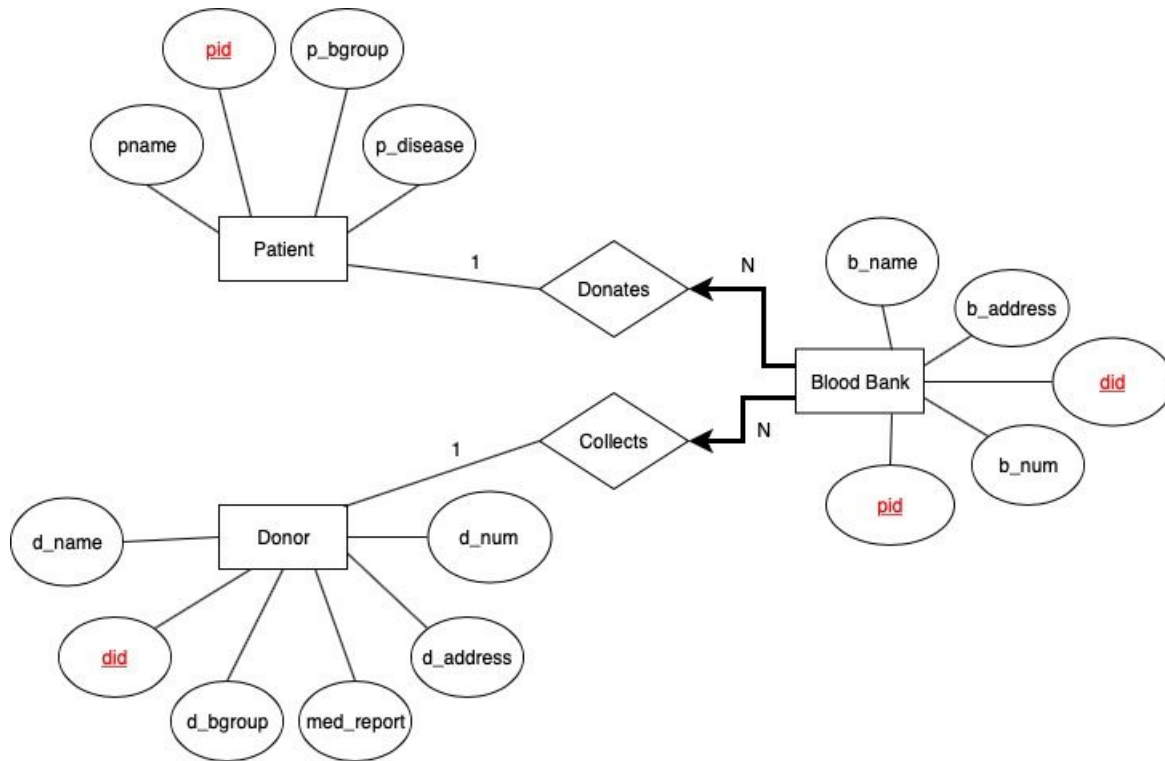


Table Representation of the Schema:

Patient

<u>pid</u>	p_name	p_bgroup	p_disease
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Donor

<u>did</u>	d_name	d_bgroup	med_report	d_address	d_num
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Blood Bank

<u>pid</u>	<u>did</u>	b_name	b_address	b_num
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Queries

- Find the *dids* of donors whose blood group is A+.

RA: $\pi_{did}(\sigma_{d_bgroup='A+'}(Donor))$

TRC: $\{T \mid \exists X \in Donor (X.d_bgroup='A+') \wedge X.did=T.did\}$

DRC: $\{\langle A \rangle \mid \langle A, B, C, D, E, F \rangle \in Donor \wedge (C='A+')\}$

- Find the *dids* of donors whose blood group is A+ or B+.

RA: $\pi_{did}(\sigma_{d_bgroup='A+' \vee 'B+'}(Donor))$

TRC: $\{T \mid \exists X \in \text{Donor} (X.d_bgroup = 'A+' \vee X.d_bgroup = 'B+') \wedge X.did = T.did\}$
 DRC: $\{\langle A \rangle \mid \langle A, B, C, D, E, F \rangle \in \text{Donor} \wedge (C = 'A+' \vee C = 'B+')\}$

3. Find the *dids* of donors whose blood group is O-.

RA: $\pi_{did}(\sigma_{d_bgroup='O-'} \text{Donor})$
 TRC: $\{T \mid \exists X \in \text{Donor} (X.d_bgroup = 'O-') \wedge X.did = T.did\}$
 DRC: $\{\langle A \rangle \mid \langle A, B, C, D, E, F \rangle \in \text{Donor} \wedge (C = 'O-')\}$

4. Find the *pid* of patients whose blood group is AB+.

RA: $\pi_{pid}(\sigma_{p_bgroup='AB+'} \text{Patient})$
 TRC: $\{T \mid \exists X \in \text{Patient} (X.p_bgroup = 'AB+') \wedge X.pid = T.pid\}$
 DRC: $\{\langle A \rangle \mid \langle A, B, C, D \rangle \in \text{Donor} \wedge (C = 'AB+')\}$

5. Find the *pid* of patients whose blood group is O+.

RA: $\pi_{pid}(\sigma_{p_bgroup='O+'} \text{Patient})$
 TRC: $\{T \mid \exists X \in \text{Patient} (X.p_bgroup = 'O+') \wedge X.pid = T.pid\}$
 DRC: $\{\langle A \rangle \mid \langle A, B, C, D \rangle \in \text{Donor} \wedge (C = 'O+')\}$

6. Find the *pids* of patients who receive blood groups A- or O-.

RA: $\pi_{pid}(\sigma_{p_bgroup='A-'} \text{Patient})$
 TRC: $\{T \mid \exists X \in \text{Patient} (X.p_bgroup = 'A-') \wedge X.pid = T.pid\}$
 DRC: $\{\langle A \rangle \mid \langle A, B, C, D \rangle \in \text{Donor} \wedge (C = 'A-')\}$

7. Find the *dids* of donors who can donate blood to anyone (O-).

RA: $\pi_{did}(\sigma_{d_bgroup='O-'} \text{Donor})$
 TRC: $\{T \mid \exists X \in \text{Donor} (X.d_bgroup = 'O-') \wedge X.did = T.did\}$
 DRC: $\{\langle A \rangle \mid \langle A, B, C, D, E, F \rangle \in \text{Donor} \wedge (C = 'O-')\}$

8. Find the *pids* of patients who can receive blood from anyone (AB+).

RA: $\pi_{pid}(\sigma_{p_bgroup='AB+'} \text{Patient})$
 TRC: $\{T \mid \exists X \in \text{Patient} (X.p_bgroup = 'AB+') \wedge X.pid = T.pid\}$
 DRC: $\{\langle A \rangle \mid \langle A, B, C, D \rangle \in \text{Donor} \wedge (C = 'AB+')\}$

9. Find the *pid* and *p_name* of patients in blood group O- from Inova Blood Donor Services with anemia.

RA: $\pi_{pid, p_name} \sigma_{p_bgroup = 'O-' \wedge p_disease = 'anemia'} (\pi_{pid} \sigma_{b_name = 'Inova Blood Donor Services'} \text{Blood Bank})$
 $\bowtie \text{Patient}$
 TRC: $\{T \mid \exists X \in \text{Patient} (\exists Y \in \text{Blood Bank} (Y.b_name = 'Inova Blood Donor Services' \wedge Y.pid = X.pid) \wedge X.p_bgroup = 'O-' \wedge X.p_disease = 'anemia') \wedge X.pid = T.pid \wedge X.p_name = T.p_name\}$
 DRC: $\{\langle A, B \rangle \mid \langle A, B, C, D \rangle \in \text{Patient} \wedge \exists E, F, G, H, I (\langle E, F, G, H, I \rangle \in \text{Blood Bank} (G =$

'Inova

Blood Donor Services) $\wedge D = 'anemia' \wedge C = 'O-'$

10. Find the *b_num* of the American Red Cross Blood Donation Center.

$RA: \pi_{b_num}(\sigma_{b_name='American Red Cross Blood Donation Center'} \cdot Blood Bank)$

$TRC: \{T \mid \exists X \in Blood Bank (X.b_name = 'American Red Cross Blood Donation Center') \wedge X.b_num = T.b_num\}$

$DRC: \{\langle E \rangle \mid \langle A, B, C, D, E \rangle \in Blood Bank \wedge (C = 'American Red Cross Blood Donation Center')\}$

11. Find the p_names of all the patients who received A- blood for suffering from liver disease.

$RA: \pi_{p_name}(\sigma_{p_bgroup='AB-' \vee 'A-'} \wedge \sigma_{p_disease='liver disease'}) Patient$

$TRC: \{T \mid \exists X \in Patient ((X.p_bgroup = 'AB-' \vee 'A-') \wedge X.p_disease = 'liver disease') \wedge$

$X.p_name = T.p_name\}$

$DRC: \{\langle C \rangle \mid \langle A, B, C, D \rangle \in Patient \wedge (C = 'AB-' \vee C = 'A-' \wedge D = 'liver disease')\}$

12. Find the p_names of the patients who received blood from the Hong Kong Red Cross Blood Transfusion Service.

$RA: \pi_{p_name}(\pi_{pid}(\sigma_{b_name='Hong Kong Red Cross Blood Transfusion Service'} \cdot Blood Bank) \bowtie Patient)$

$TRC: \{T \mid \exists X \in Blood Bank \exists Y \in Patient (X.b_name = 'Hong Kong Red Cross Blood Transfusion Service' \wedge X.pid = Y.pid) \wedge Y.p_name = T.p_name\}$

$DRC: \{\langle R \rangle \mid \langle Q, R, S, T \rangle \in Patient \wedge \exists A, B, C, D (\langle A, B, C, D, E \rangle \in Blood Bank (C = 'Hong Kong Red Cross Blood Transfusion Service' \wedge A = Q))\}$

13. Find the p_names of patients who received blood due to anemia.

$RA: \pi_{p_name}(\sigma_{p_disease='anemia'} Patient)$

$TRC: \{T \mid \exists X \in Patient (X.p_disease = 'anemia') \wedge X.p_name = T.p_name\}$

$DRC: \{\langle D \rangle \mid \langle A, B, C, D \rangle \in Patient \wedge D = 'anemia'\}$

14. Find the $b_address$ of the blood bank that donated to a patient named 'Karen Mani' suffering from hemophilia.

$RA: \pi_{b_address}(\pi_{pid}(\sigma_{p_disease='hemophilia'} \wedge \sigma_{p_name='Karen Mani'}) Patient) \bowtie Blood Bank$

$TRC: \{T \mid \exists X \in Blood Bank \exists Y \in Patient (Y.p_disease = 'hemophilia' \wedge Y.p_name = 'Karen Mani' \wedge Y.pid = X.pid) \wedge X.b_address = T.b_address\}$

$DRC: \{\langle D \rangle \mid \langle A, B, C, D, E \rangle \in Blood Bank \wedge \exists Q, R, S, T (\langle Q, R, S, T \rangle \in Patient \wedge T = 'hemophilia' \wedge R = 'Karen Mani' \wedge A = Q)\}$

15. Find the did of the donor who donated blood to "Yevgeny Smolyansky".

$RA: \pi_{did}(\pi_{pid}(\pi_{pid}(\sigma_{p_name='Yevgeny Smolyansky'}) Patient) \bowtie Blood Bank)$

$TRC: \{T \mid \exists X \in Patient \exists Y \in Blood Bank (X.p_name = 'Yevgeny Smolyansky') \wedge X.pid = Y.pid \wedge Y.did = T.did\}$

$DRC: \{\langle B \rangle \mid \langle A, B, C, D, E \rangle \in Blood Bank \wedge \exists F, G, H, I (\langle F, G, H, I \rangle \in Patient (G = 'Yevgeny$

$Smolyansky')) \wedge A = F\}$

16. Find the did of the donor named "Ethan Smith".

$RA: \pi_{did}(\sigma_{d_name='Ethan Smith'} Donor)$

$TRC: \{T \mid \exists X \in Donor (X.d_name = 'Ethan Smith') \wedge X.did = T.did\}$

$DRC: \{\langle A \rangle \mid \langle A, B, C, D, E, F \rangle \in Donor \wedge (B = 'Ethan Smith')\}$

17. Find the *did* of the donor who's a part of blood group O- with the name "John Doe".

$RA: \pi_{did}(\sigma_{d_name='John Doe'} \wedge \sigma_{d_bgroup='O-'} Donor)$

$TRC: \{T \mid \exists X \in Donor (X.d_name='John Doe' \wedge X.d_bgroup='O-') \wedge X.did=T.did\}$

$DRC: \{\langle A \rangle \mid \langle A, B, C, D, E, F \rangle \in Donor (B='Yevgeny Smolyansky' \wedge C='O-')\}$

18. Find the *b_name* of the blood bank that donated blood to patients named "Sarah Smith".

$RA: \pi_{b_name}(\pi_{pid}(\sigma_{p_name='Sarah Smith'} Patient) \bowtie Blood Bank)$

$TRC: \{T \mid \exists X \in Blood Bank \exists Y \in Patient (Y.p_name = 'Sarah Smith' \wedge Y.pid = X.pid) \wedge$

$X.b_name = T.b_name\}$

$DRC: \{\langle C \rangle \mid \langle A, B, C, D, E \rangle \in Blood Bank \wedge \exists F, G, H, I (\langle F, G, H, I \rangle \in Patient (G='Sarah Smith' \wedge F=A))\}$

19. Find the *b_name* of the blood bank that collected blood from the donor named "Jack Black" apart of blood group O-.

$RA: \pi_{b_name}(\pi_{did}(\sigma_{d_name='Jack Black'} \wedge \sigma_{d_bgroup='O-'} Donor) \bowtie Blood Bank)$

$TRC: \{T \mid \exists X \in Blood Bank \exists Y \in Donor (Y.d_name='Jack Black' \wedge Y.d_bgroup='O-') \wedge$

$Y.did=X.did \wedge X.b_name=T.b_name\}$

$DRC: \{\langle C \rangle \mid \langle A, B, C, D, E \rangle \in Blood Bank \wedge \exists F, G, H, I, J, K (\langle F, G, H, I, J, K \rangle \in Donor (G='John Doe' \wedge H='O-')) \wedge B=F\}$

20. Find the *d_name* of the donors who also received blood as patients.

*** Including SSN just for this question.***

Patient

<u>pid</u>	p_name	p_bgroup	p_disease	SSN
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Donor

<u>did</u>	d_name	d_bgroup	med_report	d_address	d_num	SSN
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Blood Bank

<u>pid</u>	<u>did</u>	b_name	b_address	b_num
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RA:

$P(pid, p_name, SSN)$

$D(did, d_name, SSN)$

$\pi_{d_name} (\sigma_{P.SSN=D.SSN} (P \times D))$

$TRC: \{T \mid \exists R1 \in Patient (\exists R2 \in Donor (R1.SSN = R2.SSN) \wedge R1.d_name =$
 $T.d_name)\}$
 $DRC: \{\langle B \rangle \mid \langle A, B, C, D, E, F, G \rangle \in Donor \wedge \exists L, M, N, O, P (\langle L, M, N, O, P \rangle \in Patient \wedge G =$
 $P)\}$