

Challenge March-2019

Offering Donated Organs for Transplant

Part 3 of a solution with DT5GL by Jack Jansonius – 3 November 2023

Problem description:

See the text on the website:

<https://dmcommunity.org/challenge/challenge-march-2019/>

In Part 2, I connected the decision tables from Part 1 to a relational database; in this case SQLite, but it could just as easily have been PostgreSQL or any other desired database.

In this part, I will continue this because:

1. especially the first 2 decision tables were too complicated because the conditions were not in order of relevance;
2. when organs were offered to individual patients and transplant centers, it was not checked whether the organ had been offered to this patient or transplant center before (and thus subsequently rejected), and
3. although the previous parts were already implicitly based on a State Transition Diagram (STD), this is now explicitly used, which has resulted in
4. an extension of functionality based on new organ states: I-Declined, TC-Declined, I-Assigned and TC-Assigned, so that organs are explicitly offered to a next patient or TC after decline (if possible) and are actually assigned to a patient or TC after acceptance.

1. Simplification of decision tables.

If the order of conditions in a decision table is not correct, i.e., not in order of relevance, this results in less comprehensible decision tables (which can then still be functionally correct).

This can be easily understood with a simple example.

For example, the selection: select all men with status 10 or 20.

Here the selection should take place first by gender and then by status.

Which produces the simple table:

```
Table
If:
person.gender = "M"
person.status = 10
person.status = 20
Then:
'Person complies with selection'
'Person doesn't comply with selection'
# .....
```

	0 1 2 3
person.gender = "M"	Y Y Y N
person.status = 10	Y N N -
person.status = 20	- Y N -
'Person complies with selection'	X X
'Person doesn't comply with selection'	X X

Reversing the conditions immediately produces a less readable decision table:

```
Table
If:
person.status = 10
person.status = 20
person.gender = "M"
Then:
'Person complies with selection'
'Person doesn't comply with selection'
# .....
```

	0 1 2 3 4
person.status = 10	Y Y N N N
person.status = 20	- - Y Y N
person.gender = "M"	Y N Y N -
'Person complies with selection'	X X
'Person doesn't comply with selection'	X X X

This is exactly what is wrong with the first 2 tables in my previous solutions.

The first condition 'DUOBLOCK/Fallback is (still) possible' should not have been there at all.

This is because for each organ, regardless of the status of the other organ:

If status of organ is I-available, and
there is a patient present on the relevant waiting list,
then organ offers to patient on relevant waiting list.

Only if the 2nd condition fails is the status of the other organ of interest:

If status of organ is I-available, and
there is not a patient present on the corresponding waiting list, and
the status of the other organ is not: NotAvailable, I-Accepted, I-Assigned
Then put the organ in a waiting state.

So I had mistakenly put this third condition in the first place in my previous solutions.

Altogether, a correct ordering of the conditions now yields a much more readable decision table:

```
rTable 1b: Offer a declined or new available heart.
If:
'Heart is new or declined by patient'          | 0 | 1 | 2 |
'Another patient for this organ on Heart Prio List' | Y | Y | Y |
'Wait for the lungs'                          | - | Y | N |
Then:
Action is Offer_Heart_to_Patient              | X |   |   |
H_Stat is TC-Wait                            |   | X |   |
H_Stat is TC-Available                       |   |   | X |
# .....
```

where the first and third conditions are derived from a condition sub-table:

```
rTable 1c:
If:
H_Stat_inp is I-Available                    | 0 | 1 |
H_Stat_inp is I-Declined                    | - | Y |
Then:
'Heart is new or declined by patient'       | X | X |
# .....
```

```
rTable 1d:
If:
L_Stat_inp is NotAvailable                  | 0 |
L_Stat_inp is I-Accepted                   | N |
L_Stat_inp is I-Assigned                   | N |
Then:
'Wait for the lungs'                       | X |
# .....
```

and the second condition is determined based on a proposition:

```
Proposition: 'Another patient for this organ on Heart Prio List'
Obtain_instance_from_database_view: patient_for_heart
```

With this proposition, we have arrived at the next point.

2. Organ after decline not offering again to same patient or TC.

For some reason, Part 2 did not check whether an organ had been offered before and thus declined by a patient or transplant center.

While before this I had already created the data fields in the entities lung offer and heart offer, namely: `response_date` and `response_id`.

If these fields are filled correctly after a rejection by a patient or TC, with `response_id` the value 1 (=declined), it can be prevented that the organ is later offered again to this patient or TC.

Therefore, the proposition 'Another patient on Heart Prio List', linked to the database view `high_prio_heart_list`, is now replaced by: 'Another patient for this organ on Heart Prio List', linked to the database view `patient_for_heart`.

Of course, the same applies to lungs.

Handling declined organs does necessitate the use of a **multivalued** goal attribute only (where part 2 could also still be realized with a singlevalued goal attribute). Indeed, handling a declined organ requires 2 consecutive actions, as reflected in the case-statements of the goal attribute.

The actions after proving:
`Rejection_Heart_by_Patient` and/or
`Rejection_Lungs_by_Patient`

are followed by 1 or 2 of the following actions:

`Offer_Heart_to_Patient`
`Offer_Lungs_to_Patient`
`Heart_waits_for_TC`
`Lungs_wait_for_TC`
`Offer_single_Heart_to_TC`
`Offer_single_Lungs_to_TC`
`Offer_Heart/Lung-block_to_TC`
`Heart_not_accepted`
`Lungs_nog_accepted`
`Heart/Lung-block_not_accepted`

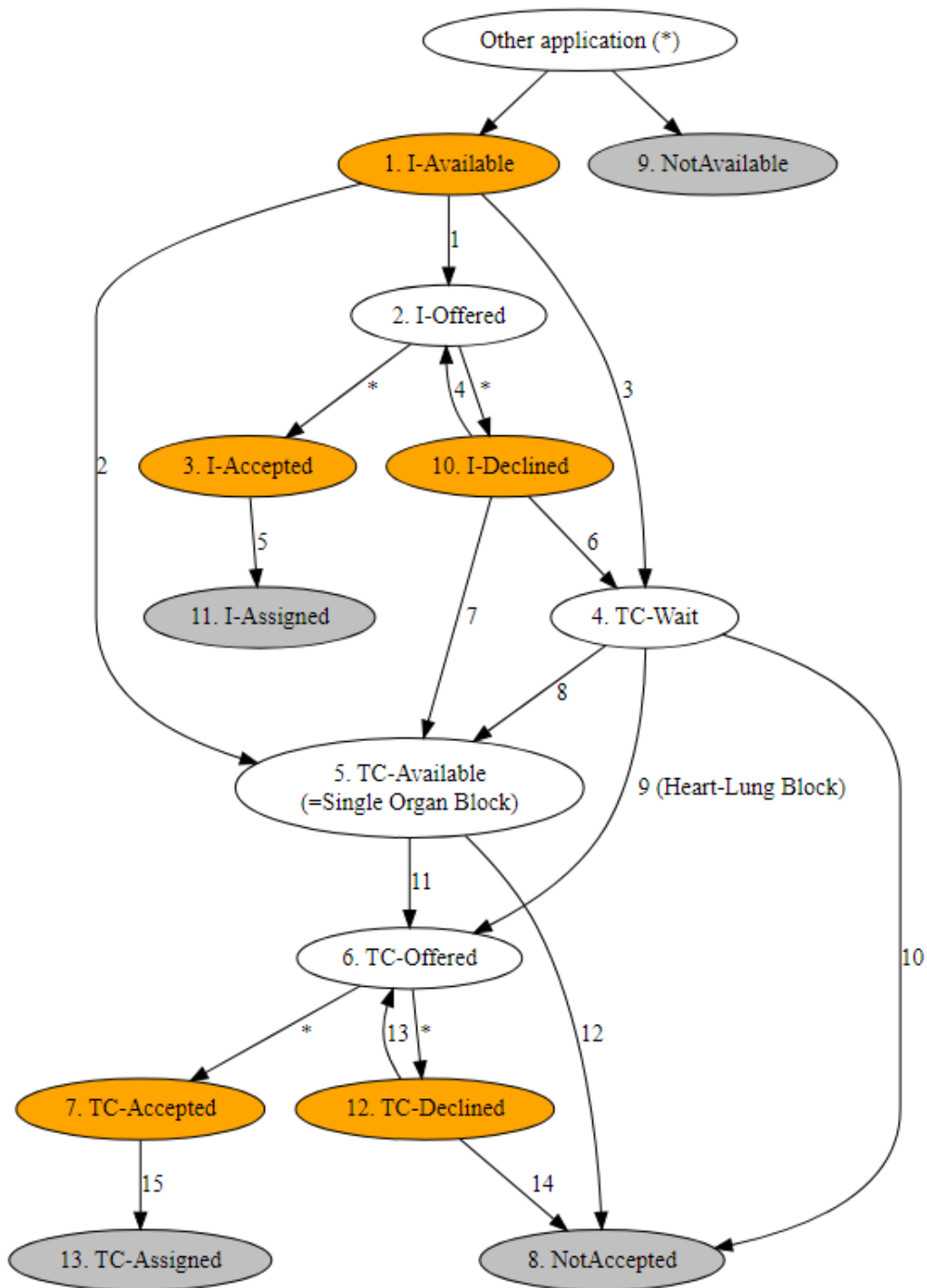
as reflected in the State Transition Diagram (STD) at the next item.

The former actions ensure that the patient who declined the organ becomes available again on the corresponding waiting list for a subsequent organ offer (by setting the `availability_id` field to 1) and that the `response_date` and `response_id` fields of the corresponding organ offer are filled with the time of declination and `response_id` = 1 (declined).

The same applies to the action's:
`Rejection_Heart_by_TC`
`Rejection_Lungs_by_TC`
`Rejection_Heart/Lung-block_by_TC`

which can be followed by:
`Offer_single_Heart_to_TC`
`Offer_single_Lungs_to_TC`
`Offer_Heart/Lung-block_to_TC`
`Heart_not_accepted`
`Lungs_nog_accepted`
`Heart/Lung-block_not_accepted`

3. State Transition Diagram (STD) for the solution (with Graphviz)¹

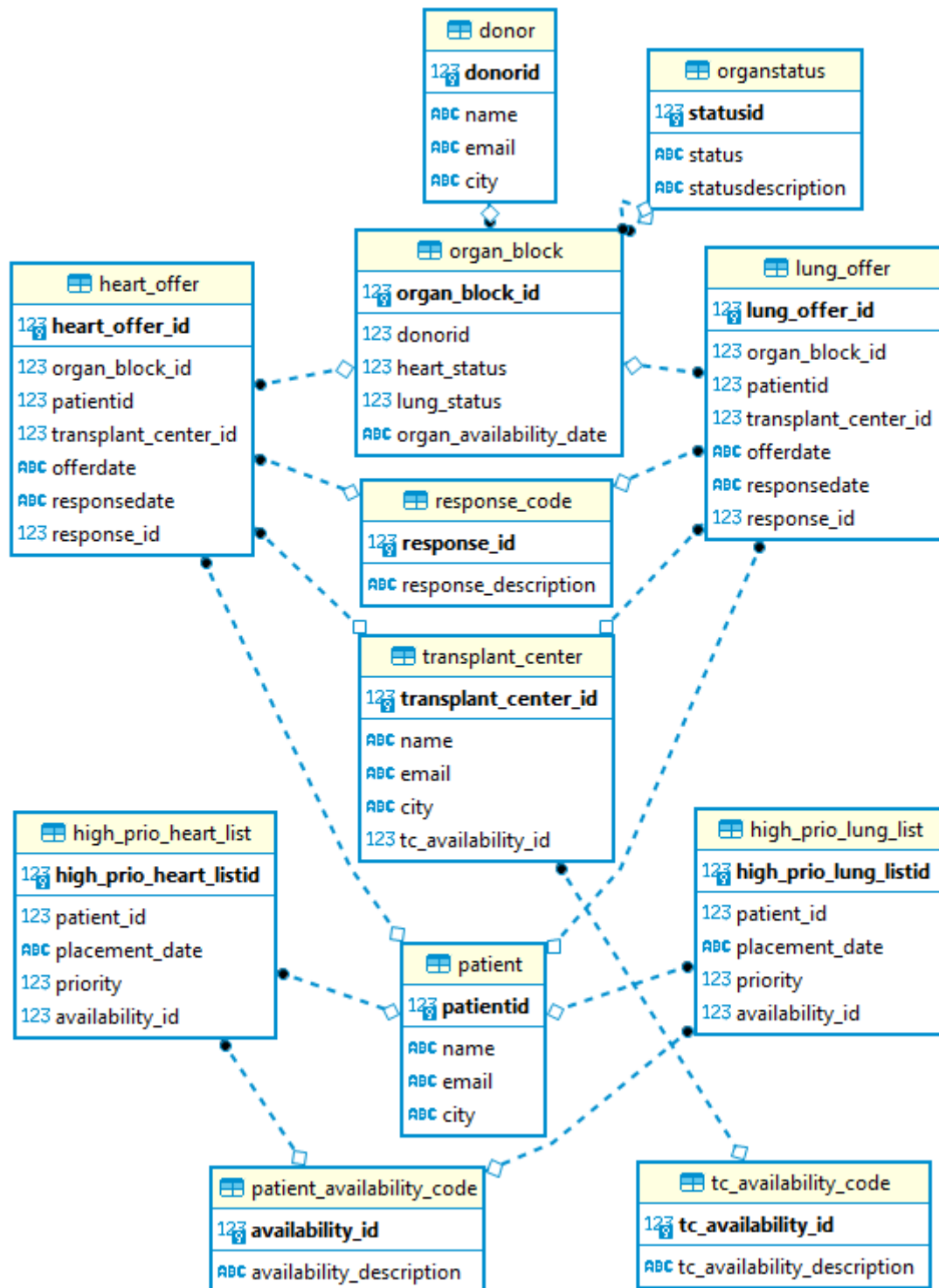


¹ Diagram created with <https://dreampuf.github.io/GraphvizOnline/>
See appendix for the code to create the above diagram.

The paths in this STD that apply to both organs in an organ block provide exactly all interesting test cases:

1. Organ is I-Available and there is a patient on the corresponding waiting list, so it is offered to this patient, and given status I-Offered (regardless of the status of the other organ in the block).
2. Organ is I-Available and there is not a patient on the corresponding waiting list and the other organ is not present (NotAvailable), then this single organ becomes immediately available for offer to a TC (with temporary status TC-available).
3. Organ is I-Available and there is not a patient on the relevant waiting list and other organ is I-Available and there is also not a patient on the waiting list for this organ, then both organs enter temporary status TC-wait, to be subsequently offered as an organ block to available TCs.
4. Organ is refused by patient (I-Declined) and there is a next patient on the corresponding waiting list (who was not offered the organ before), then the organ is offered to this patient and gets status I-Offered.
5. Organ is accepted by patient (I-Accepted) and can now be assigned to this patient (I-assigned).
6. Organ has been refused by patient (I-Declined) and there is not a next patient on the respective waiting list and the other organ does not have status NotAvailable, I-Accepted or I-Assigned, then the organ is given status TC-wait, to then be offered to available TCs as an organ block pending the other organ.
7. Organ is refused by patient (I-Declined) and there is not a next patient on the relevant waiting list and the other organ does have status NotAvailable, I-Accepted or I-Assigned, then the organ enters temporary status TC-available, to be offered as a single organ block to available TCs.
8. Organ with status TC-Wait enters temporary status TC-available, to be offered as single organ block to available TCs, if the other organ is accepted by the patient (via status TC-Accepted).
9. If both organs have or receive TC-Wait status and there is a transplant center available for an offer, the organs are offered as heart-long block to this tc; both organs receive TC-Offered status.
10. If both organs have or receive status TC-Wait and there is not a transpantation center available for an offer, then the organs are removed from the offering process with status NotAccepted.
11. An organ with temporary status TC-available is offered as a single organ block to an available TC and is given status TC-Offered. The other organ in the block is not available (NotAvailable) or already accepted by a patient (I-Accepted, I-Assigned).
12. An organ with temporary status TC-available is removed from the offering process with status NotAccepted if a TC is not available for an offering. The other organ in the block is not present or already accepted by a patient.
13. If both organs in an organ block are rejected by a TC (status TC-Declined), both organs are offered as a block to a subsequent TC if available.
If one organ in an organ block is declined by a TC (status TC-Declined), this organ is offered to a subsequent TC if available. The other organ has status NotAvailable or I-Assigned or TC-Accepted.
14. As 13, but now there is not a TC available for an offer and the organs or single organ is removed from the offer process with status NotAccepted.
15. If both organs in an organ block are accepted by a TC (status TC-Accepted), both organs are given status TC-Assigned.
If one organ in an organ block is accepted by a TC (status TC-Accepted), this organ is given status TC-Assigned; the other organ has status NotAvailable or I-Assigned (no follow-up action) or TC-Declined (→ paths 13/14).

ER-schema for the solution (with Dbeaver/SQLite)²



² This entity-relationship diagram (ERD) is similar to Part 2; only the h_stat and l_stat fields in organ_block have been changed to heart_status and lung_status. Contains much more details in reality, of course; kept as simple as possible here. And in that respect can also be called a conceptual schema.

The following status tables of interest:

Organ status:

statusid	status	statusdescription
0	Initial	Initial
1	I-Available	Available for individual patients.
2	I-Offered	Offered to an individual patient.
3	I-Accepted	Accepted by an individual patient.
4	TC-Wait	Fallback
5	TC-Available	Available for transplant centers.
6	TC-Offered	Offered to a transplant center.
7	TC-Accepted	Accepted by a transplant center.
8	NotAccepted	Not accepted by any individual patient
9	NotAvailable	Not available
10	I-Declined	Declined by an individual patient.
11	I-Assigned	Assigned to an individual patient.
12	TC-Declined	Declined by a transplant center.
13	TC-Assigned	Assigned to a transplant center.

Patient_availability_code:

availability_id	availability_description
1	1 Available for an organ offer
2	2 Temporarily unavailable; an organ is currently being offered to the patient.
3	3 Temporarily unavailable; condition of the patient is currently insufficient
4	4 Definitely not available; patient has already accepted an organ.
5	5 Definitely not available; patient has passed away in the meantime

Tc_availability_code:

tc_availability_id	tc_availability_description
1	1 Available for organ offer
2	2 Not available for organ offer

Response_code:

response_id	response_description
1	Declined
2	Accepted

Implementation of the decision tables in DT5GL:

```
# Simplification of decision tables based on a State Transition Diagram
# New organ states:
# 10. I-Declined, 11. I-Assigned, 12. TC-Declined, 13. TC-Assigned

# Organ-states:
# 1. I-Available    = Available for individual patients
#                   (INITIAL STATE, from other application). <=
# 2. I-Offered      = Offered to an individual patient.
# 10. I-Declined    = Declined by an individual patient.
#                   (from other application) <=
# 3. I-Accepted     = Accepted by an individual patient.
#                   (from other application) <=
# 11. I-Assigned    = Assigned to an individual patient (END STATE).
# 4. TC-Wait        = Fallback
# 5. TC-Available   = Available for transplant centers.
# 6. TC-Offered     = Offered to a transplant center.
# 12. TC-Declined   = Declined by a transplant center.
#                   (from other application) <=
# 7. TC-Accepted    = Accepted by a transplant center.
#                   (from other application) <=
# 13. TC-Assigned   = Assigned to a transplant center (END STATE).
# 8. NotAccepted    = Not accepted by an individual patient or transplant center
#                   (END STATE).
# 9. NotAvailable   = Not available (END STATE, from other application). <=
#

SQLite_database: "Database/organdonation2.sqlite"

rTable 0: Next organ to handle?
If: | 0|
'Still organs to handle' | N|
Then:
Action is Organ_handling_finished | X|
# .....

Proposition: 'Still organs to handle'
Obtain_instance_from_database_view: organ_block
```



```

rTable 1a: Handle heart if declined by patient first.
If:
Heart_Status_DB is I-Declined
Then:
Action is Rejection_Heart_by_Patient
# .....

```

```

rTable 1b: Offer a declined or new available heart to an individual patient,
a transplant center or a wait for this.
If:
'Heart is new or declined by patient'
'Another patient for this organ on Heart Prio List'
'Wait for the lungs'
Then:
Action is Offer_Heart_to_Patient
Heart_Status_tmp is TC-Wait
Heart_Status_tmp is TC-Available
# .....

```

```

rTable 1c:
If:
Heart_Status_DB is I-Available
Heart_Status_DB is I-Declined
Then:
'Heart is new or declined by patient'
# .....

```

```

Attribute: Heart_Status_DB
Obtain_value_from_database_view: organ_block.heart_status

```

```

Proposition: 'Another patient for this organ on Heart Prio List'
Obtain_instance_from_database_view: patient_for_heart

```

```

rTable 1d:
If:
Lung_Status_DB is NotAvailable
Lung_Status_DB is I-Accepted
Lung_Status_DB is I-Assigned
Then:
'Wait for the lungs'
# .....

```

```

rTable 1e: Offer the waiting heart to a transplant center, if the lungs are accepted
by a patient.
If:
Heart_Status_DB is TC-Wait
Lung_Status_DB is I-Accepted
Then:
Heart_Status_tmp is TC-Available
# .....
# NB: The heart cannot be in a waiting state if the lungs are not available within a
block.

```

```

rTable 1f: Assign an accepted heart to the patient.
If:
Heart_Status_DB is I-Accepted
Then:
Action is Assign_Heart_to_Patient
# .....

```

```

rTable 2a : Handle lungs if declined by patient first.
If: | 0|
Lung_Status_DB is I-Declined | Y|
Then:
Action is Rejection_Lungs_by_Patient | X|
# .....

```

rTable 2b: Offer declined or new available lungs to an individual patient, a transplant center or a wait for this.

```

If: | 0| 1| 2|
'Lungs are new or declined by patient' | Y| Y| Y|
'Another patient for this organ on Lung Prio List' | Y| N| N|
'Wait for the heart' | -| Y| N|
Then:
Action is Offer_Lungs_to_Patient | X| | |
Lung_Status_tmp is TC-Wait | | X| |
Lung_Status_tmp is TC-Available | | | X|
# .....

```

rTable 2c:

```

If: | 0| 1|
Lung_Status_DB is I-Available | Y| N|
Lung_Status_DB is I-Declined | -| Y|
Then:
'Lungs are new or declined by patient' | X| X|
# .....

```

Attribute: Lung_Status_DB

Obtain_value_from_database_view: organ_block.lung_status

Proposition: 'Another patient for this organ on Lung Prio List'

Obtain_instance_from_database_view: patient_for_lung

rTable 2d:

```

If: | 0|
Heart_Status_DB is NotAvailable | N|
Heart_Status_DB is I-Accepted | N|
Heart_Status_DB is I-Assigned | N|
Then:
'Wait for the heart' | X|
# .....

```

rTable 2e: Offer the waiting lungs to a transplant center, if the heart is accepted by a patient.

```

If: | 0|
Lung_Status_DB is TC-Wait | Y|
Heart_Status_DB is I-Accepted | Y|
Then:
Lung_Status_tmp is TC-Available | X|
# .....

```

NB: The lungs cannot be in a waiting state if the heart is not available within a block.

rTable 2f: Assign accepted lungs to the patient.

```

If: | 0|
Lung_Status_DB is I-Accepted | Y|
Then:
Action is Assign_Lungs_to_Patient | X|
# .....

```

rTable 3: Offer a heart-lung block to a transplant center for the first time (fallback-scenario)

```

If: | 0 | 1 | 2 |
Heart_Status_tmp is TC-Wait | Y | Y | N |
Lung_Status_tmp is TC-Wait | Y | - | Y |
Heart_Status_DB is TC-Wait | - | - | Y |
Lung_Status_DB is TC-Wait | - | Y | - |
Then:
'Heart-Lung Block to TC for the first time' | X | X | X |
# .....

```

rTable 4: Handle single organ or heart-lung block if declined by TC first.

```

If: | 0 | 1 | 2 |
Heart_Status_DB is TC-Declined | Y | Y | N |
Lung_Status_DB is TC-Declined | Y | N | Y |
Then:
Action is Rejection_Heart/Lung-block_by_TC | X | | |
Action is Rejection_Heart_by_TC | | X | |
Action is Rejection_Lungs_by_TC | | | X |
# .....

```

rTable 5: Heart-Lung Block to TC for the first time.

```

If: | 0 | 1 |
'Heart-Lung Block to TC for the first time' | Y | Y |
'Another Transplant Center on TC list' | Y | N |
Then:
Action is Offer_Heart/Lung-block_to_TC/1 | X | |
Action is Heart/Lung-block_not_accepted | | X |
# .....

```

Proposition: 'Another Transplant Center on TC list'
Obtain_instance_from_database_view: transplant_center

rTable 6: Declined Heart-Lung Block to next TC or not accepted

```

If: | 0 | 1 |
Heart_Status_DB is TC-Declined | Y | Y |
Lung_Status_DB is TC-Declined | Y | Y |
'Another TC for this heart on TC list' | Y | N |
Then:
Action is Offer_Heart/Lung-block_to_TC/2 | X | |
Action is Heart/Lung-block_not_accepted | | X |
# .....

```

Proposition: 'Another TC for this heart on TC list'
Obtain_instance_from_database_view: TC_for_heart

rTable 7: Heart as single organ: new for TC or declined by TC.

```

If: | 0 | 1 | 2 | 3 |
Heart_Status_tmp is TC-Available | Y | Y | N | N |
Heart_Status_DB is TC-Declined | - | - | Y | Y |
Lung_Status_DB is TC-Declined | - | - | N | N |
'Another TC for this heart on TC list' | Y | N | Y | N |
Then:
Action is Offer_single_Heart_to_TC | X | | X | |
Action is Heart_not_accepted | | X | | X |
# .....
# TC-Available implies single organ:
# the other organ is NotAvailable, I-Accepted, I-Assigned

```

```

rTable 8: Lungs as single organ: new for TC or declined by TC.
If:
Lung_Status_tmp is TC-Available          | 0| 1| 2| 3|
Heart_Status_DB is TC-Declined          | Y| Y| N| N|
Lung_Status_DB is TC-Declined           | -| -| Y| Y|
'Another TC for these lungs on TC list'  | Y| N| Y| N|
Then:
Action is Offer_single_Lungs_to_TC      | X|  | X|  |
Action is Lungs_not_accepted            |  | X|  | X|
# .....
# TC-Available implies single organ:
# the other organ is NotAvailable, I-Accepted, I-Assigned

```

```

Proposition: 'Another TC for these lungs on TC list'
Obtain_instance_from_database_view: TC_for_lungs

```

```

rTable 9: Assign accepted organs to the related TC.
If:
Heart_Status_DB is TC-Accepted          | Y| Y| N|
Lung_Status_DB is TC-Accepted          | Y| N| Y|
Then:
Action is Assign_Heart/Lung-block_to_TC | X|  |  |
Action is Assign_single_Heart_to_TC     |  | X|  |
Action is Assign_single_Lungs_to_TC     |  |  | X|
# .....

```

```

rTable 10: Only the heart or the lungs come into a wait state (fallback scenario)
If:
'Heart-Lung Block to TC for the first time' | N| N|
Heart_Status_tmp is TC-Wait                 | Y| N|
Lung_Status_tmp is TC-Wait                 | N| Y|
Then:
Action is Heart_waits_for_TC                | X|  |
Action is Lungs_wait_for_TC                 |  | X|
# .....

```

```

##### Database views #####
Database_view: organ_block
With_attributes:
organ_block_id,donorid,name,heart_status,lung_status,organ_availability_date
Query:
SELECT a.organ_block_id,
       b.donorid,
       b.name,
       c.status AS heart_status,
       d.status AS lung_status,
       a.organ_availability_date
FROM   organ_block AS a
       INNER JOIN
       donor AS b ON (a.donorid = b.donorid)
       INNER JOIN
       organstatus AS c ON (a.heart_status = c.statusid)
       INNER JOIN
       organstatus AS d ON (a.lung_status = d.statusid)
WHERE  c.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined") OR
       d.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined")
ORDER BY organ_availability_date ASC
LIMIT 1
End_Query

```

Database_view: patient_for_heart
With_attributes: patient_id
Query:
SELECT patient_id
FROM high_prio_heart_list AS a
WHERE availability_id = 1 AND
patient_id NOT IN (
SELECT patientid
FROM heart_offer AS b
WHERE b.patientid = a.patient_id
AND b.organ_block_id = %s
AND b.response_id = 1)
ORDER BY priority DESC,
placement_date ASC
LIMIT 1
With_arguments: organ_block.organ_block_id

Database_view: patient_for_lung
With_attributes: patient_id
Query:
SELECT patient_id
FROM high_prio_lung_list AS a
WHERE availability_id = 1 AND
patient_id NOT IN (
SELECT patientid
FROM lung_offer AS b
WHERE b.patientid = a.patient_id
AND b.organ_block_id = %s
AND b.response_id = 1)
ORDER BY priority DESC,
placement_date ASC
LIMIT 1
With_arguments: organ_block.organ_block_id

Database_view: transplant_center
With_attributes: transplant_center_id, name, tc_availability_id
Query:
SELECT transplant_center_id,
name,
tc_availability_id
FROM transplant_center
WHERE tc_availability_id = 1
LIMIT 1
End_Query

Database_view: TC_for_heart
With_attributes: transplant_center_id, name, tc_availability_id
Query:
SELECT transplant_center_id,
name,
tc_availability_id
FROM transplant_center AS a
WHERE tc_availability_id = 1
AND transplant_center_id NOT IN (
SELECT transplant_center_id
FROM heart_offer AS b
WHERE b.transplant_center_id = a.transplant_center_id
AND b.organ_block_id = %s
AND b.response_id = 1)
LIMIT 1
With_arguments: organ_block.organ_block_id

Database_view: TC_for_lungs
With_attributes: transplant_center_id, name, tc_availability_id
Query:

```
SELECT transplant_center_id,  
       name,  
       tc_availability_id  
FROM transplant_center AS a  
WHERE tc_availability_id = 1  
      AND transplant_center_id NOT IN (  
        SELECT transplant_center_id  
        FROM lung_offer AS b  
        WHERE b.transplant_center_id = a.transplant_center_id  
              AND b.organ_block_id = %s  
              AND b.response_id = 1)  
LIMIT 1
```

With_arguments: organ_block.organ_block_id

```
# availability_id    = 1 (AVAILABLE) 2 (Temp Unavailable) 4 (Def Unavailable)  
# tc_availability_id = 1 (AVAILABLE) 2 = not available  
# response_id       = 1 (DECLINED) 2 = ACCEPTED
```

GoalAttributes

#Overview Actions:

```
#Case: No_Organs_To_Offer  
#Case: Rejection_Heart_by_Patient  
#Case: Rejection_Lungs_by_Patient  
#Case: Offer_Heart_to_Patient  
#Case: Offer_Lungs_to_Patient  
#Case: Assign_Heart_to_Patient  
#Case: Assign_Lungs_to_patient  
  
#Case: Heart_waits_for_TC  
#Case: Lungs_wait_for_TC  
  
#Case: Rejection_Heart_by_TC  
#Case: Rejection_Lungs_by_TC  
#Case: Rejection_Heart/Lung-block_by_TC  
  
#Case: Offer_single_Heart_to_TC  
#Case: Offer_single_Lungs_to_TC  
#Case: Offer_Heart/Lung-block_to_TC/1  
#Case: Offer_Heart/Lung-block_to_TC/2  
#Case: Assign_single_Heart_to_TC  
#Case: Assign_single_Lungs_to_TC  
#Case: Assign_Heart/Lung-block_to_TC  
#Case: Heart_not_accepted  
#Case: Lungs_nog_accepted  
#Case: Heart/Lung-block_not_accepted
```

GoalAttribute: Action

Repeat_until: Organ_handling_finished

MultiValued_until: Organ_handling_finished

Case: Organ_handling_finished

Print: "=====Result====="

Print: "No organs to handle anymore. "

Print: "The organ handling service has been finished"

Print: "====="

Case: Rejection_Heart_by_Patient

Print: "> The heart in the organ block %s from donor %s is declined by the patient."

organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE high_prio_heart_list "

-SQL: " SET availability_id = 1 "

-SQL: " WHERE patient_id = (SELECT patientid FROM heart_offer "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE heart_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 1 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

Case: Rejection_Lungs_by_Patient

Print: "> The lungs in the organ block %s from donor %s are declined by the patient."

organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE high_prio_lung_list "

-SQL: " SET availability_id = 1 "

-SQL: " WHERE patient_id = (SELECT patientid FROM lung_offer "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE lung_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 1 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

Case: Offer_Heart_to_Patient

Print: "Offer the heart to patient %s on the heart prio list"

patient_for_heart.patient_id

Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id

organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET heart_status = 2 "

<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "INSERT INTO heart_offer (organ_block_id, patientid, offerdate) "

-SQL: "VALUES (%s, " organ_block.organ_block_id

-SQL: "%s, " patient_for_heart.patient_id

<SQL: "%s) " DateToday

>SQL: "UPDATE high_prio_heart_list SET availability_id = 2 "

<SQL: "WHERE patient_id = %s" patient_for_heart.patient_id

Case: Offer_Lungs_to_Patient

Print: "Offer the lungs to patient %s on the lung prio list"

patient_for_lung.patient_id

Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id

organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET lung_status = 2 "

<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "INSERT INTO lung_offer (organ_block_id, patientid, offerdate) "

-SQL: "VALUES (%s, " organ_block.organ_block_id

-SQL: "%s, " patient_for_lung.patient_id

<SQL: "%s) " DateToday

>SQL: "UPDATE high_prio_lung_list SET availability_id = 2 "

<SQL: "WHERE patient_id = %s" patient_for_lung.patient_id

Case: Assign_Heart_to_Patient

Print: "The heart in the organ block %s from donor %s is assigned to the patient."
organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET heart_status = 11 "

<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "UPDATE high_prio_heart_list "

-SQL: " SET availability_id = 4 "

-SQL: " WHERE patient_id = (SELECT patientid FROM heart_offer "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE heart_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 2 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

Case: Assign_Lungs_to_Patient

Print: "The lungs in the organ block %s from donor %s are assigned to the patient."
organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET lung_status = 11 "

<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "UPDATE high_prio_lung_list "

-SQL: " SET availability_id = 4 "

-SQL: " WHERE patient_id = (SELECT patientid FROM lung_offer "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE lung_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 2 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

Case: Heart_waits_for_TC

Print: "The heart is waiting now for a block-offer to a transplant center."

Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET heart_status = 4 "

<SQL: "WHERE donorid = %s" organ_block.donorid

Case: Lungs_wait_for_TC

Print: "The lungs are waiting now for a block-offer to a transplant center."

Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET lung_status = 4 "

<SQL: "WHERE donorid = %s" organ_block.donorid

Case: Rejection_Heart_by_TC

Print: "> The heart in the organ block %s from donor %s is declined by the transplant center." organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE transplant_center "

-SQL: " SET tc_availability_id = 1 "

-SQL: " WHERE transplant_center_id = (SELECT transplant_center_id FROM heart_offer "

-SQL: " WHERE organ_block_id = %s "

organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE heart_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 1 "

-SQL: " WHERE organ_block_id = %s "

organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

Case: Rejection_Lungs_by_TC

Print: "> The lungs in the organ block %s from donor %s is declined by the transplant center." organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE transplant_center "

-SQL: " SET tc_availability_id = 1 "

-SQL: " WHERE transplant_center_id = (SELECT transplant_center_id FROM lung_offer "

-SQL: " WHERE organ_block_id = %s "

organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE lung_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 1 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

Case: Rejection_Heart/Lung-block_by_TC

Print: "> The Heart/Lung-block %s from donor %s is declined by the transplant center." organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE transplant_center "

-SQL: " SET tc_availability_id = 1 "

-SQL: " WHERE transplant_center_id = (SELECT transplant_center_id FROM heart_offer "

-SQL: " WHERE organ_block_id = %s "

organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE heart_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 1 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

>SQL: "UPDATE lung_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 1 "

-SQL: " WHERE organ_block_id = %s "

organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

```

Case: Offer_single_Heart_to_TC
Print: "Offer the heart to a next transplant center: %s" TC_for_heart.name
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======"
>SQL: "UPDATE organ_block SET heart_status = 6 "
<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "INSERT INTO heart_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL: "VALUES (%s, " organ_block.organ_block_id
-SQL: "%s, " TC_for_heart.transplant_center_id
<SQL: "%s) " DateToday
>SQL: "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL: "WHERE transplant_center_id = %s" TC_for_heart.transplant_center_id

```

```

Case: Offer_single_Lungs_to_TC
Print: "Offer the lungs to a next transplant center: %s" TC_for_lungs.name
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======"
>SQL: "UPDATE organ_block SET lung_status = 6 "
<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "INSERT INTO lung_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL: "VALUES (%s, " organ_block.organ_block_id
-SQL: "%s, " TC_for_lungs.transplant_center_id
<SQL: "%s) " DateToday
>SQL: "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL: "WHERE transplant_center_id = %s" TC_for_lungs.transplant_center_id

```

```

Case: Offer_Heart/Lung-block_to_TC/1
Print: "Offer heart-lung block for the first time to a transplant center: %s"
transplant_center.name
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======"
>SQL: "UPDATE organ_block SET heart_status = 6, lung_status = 6 "
<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "INSERT INTO heart_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL: "VALUES (%s, " organ_block.organ_block_id
-SQL: "%s, " transplant_center.transplant_center_id
<SQL: "%s) " DateToday
>SQL: "INSERT INTO lung_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL: "VALUES (%s, " organ_block.organ_block_id
-SQL: "%s, " transplant_center.transplant_center_id
<SQL: "%s) " DateToday
>SQL: "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL: "WHERE transplant_center_id = %s" transplant_center.transplant_center_id

```

```

Case: Offer_Heart/Lung-block_to_TC/2
Print: "Offer heart-lung block to a next transplant center: %s" TC_for_heart.name
Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id
organ_block.name
Print: "======"
>SQL: "UPDATE organ_block SET heart_status = 6, lung_status = 6 "
<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "INSERT INTO heart_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL: "VALUES (%s, " organ_block.organ_block_id
-SQL: "%s, " TC_for_heart.transplant_center_id
<SQL: "%s) " DateToday
>SQL: "INSERT INTO lung_offer (organ_block_id, transplant_center_id, offerdate) "
-SQL: "VALUES (%s, " organ_block.organ_block_id
-SQL: "%s, " TC_for_heart.transplant_center_id
<SQL: "%s) " DateToday
>SQL: "UPDATE transplant_center SET tc_availability_id = 2 "
<SQL: "WHERE transplant_center_id = %s" TC_for_heart.transplant_center_id

```

```

Case: Assign_single_Heart_to_TC
Print: "The heart in the organ block %s from donor %s is assigned to the Transplant
Center." organ_block.organ_block_id organ_block.name
Print: "======"
>SQL: "UPDATE organ_block SET heart_status = 13 "
<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "UPDATE transplant_center "
-SQL: " SET tc_availability_id = 1 "
-SQL: " WHERE transplant_center_id = (SELECT transplant_center_id FROM heart_offer "
-SQL: " WHERE organ_block_id = %s "
organ_block.organ_block_id
<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE heart_offer "
-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "
-SQL: " response_id = 2 "
-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id
<SQL: " AND respondedate is NULL "

```

```

Case: Assign_single_Lungs_to_TC
Print: "The lungs in the organ block %s from donor %s are assigned to the Transplant
Center." organ_block.organ_block_id organ_block.name
Print: "======"
>SQL: "UPDATE organ_block SET lung_status = 13 "
<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "UPDATE transplant_center "
-SQL: " SET tc_availability_id = 1 "
-SQL: " WHERE transplant_center_id = (SELECT transplant_center_id FROM lung_offer "
-SQL: " WHERE organ_block_id = %s "
organ_block.organ_block_id
<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE lung_offer "
-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "
-SQL: " response_id = 2 "
-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id
<SQL: " AND respondedate is NULL "

```

Case: Assign_Heart/Lung-block_to_TC

Print: "The Heart/Lung-block %s from donor %s is assigned to the Transplant Center."

organ_block.organ_block_id organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET heart_status = 13, lung_status = 13 "

<SQL: "WHERE donorid = %s" organ_block.donorid

>SQL: "UPDATE transplant_center "

-SQL: " SET tc_availability_id = 1 "

-SQL: " WHERE transplant_center_id = (SELECT transplant_center_id FROM heart_offer "

-SQL: " WHERE organ_block_id = %s "

organ_block.organ_block_id

<SQL: " AND respondedate is NULL) "

>SQL: "UPDATE heart_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 2 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

>SQL: "UPDATE lung_offer "

-SQL: " SET respondedate = datetime(offerdate, '+1 hour'), "

-SQL: " response_id = 2 "

-SQL: " WHERE organ_block_id = %s " organ_block.organ_block_id

<SQL: " AND respondedate is NULL "

Case: Heart_not_accepted

Print: "The heart is not accepted by patients or transplantation centers."

Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id

organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET heart_status = 8 "

<SQL: "WHERE donorid = %s" organ_block.donorid

Case: Lungs_not_accepted

Print: "The lungs have not been accepted by patients or transplant centers."

Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id

organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET lung_status = 8 "

<SQL: "WHERE donorid = %s" organ_block.donorid

Case: Heart/Lung-block_not_accepted

Print: "Neither the heart nor the lungs have been accepted by patients or transplantation centres."

Print: "This concerns organ block %s from donor %s." organ_block.organ_block_id

organ_block.name

Print: "=====

>SQL: "UPDATE organ_block SET heart_status = 8, lung_status = 8 "

<SQL: "WHERE donorid = %s" organ_block.donorid

Database setups

Initial_database_setup: delete_organ_blocks

Query:

```
DELETE FROM organ_block
```

End_Query

Initial_database_setup: insert_new_organ_blocks

Query:

```
INSERT INTO organ_block (organ_availability_date, lung_status, heart_status,  
donorid, organ_block_id)3
```

VALUES

```
('2023-06-05', 1, 1, 1, 1),  
( '2023-06-06', 1, 1, 2, 2),  
( '2023-06-11', 1, 1, 3, 3),  
( '2023-06-05', 0, 0, 4, 4),  
( '2023-06-07', 0, 0, 5, 5)
```

End_Query

Initial_database_setup: delete_heart_offer

Query:

```
DELETE FROM heart_offer
```

End_Query

Initial_database_setup: delete_lung_offer

Query:

```
DELETE FROM lung_offer
```

End_Query

Initial_database_setup: delete_high_prio_heart_list

Query:

```
DELETE FROM high_prio_heart_list
```

End_Query

Initial_database_setup: insert_high_prio_heart_list

Query:

```
INSERT INTO high_prio_heart_list
```

```
(availability_id, priority, placement_date, patient_id, high_prio_heart_listid)
```

VALUES

```
(1, 90, '2023-05-31', 1, 1),  
(1, 90, '2023-06-08', 2, 2),  
(1, 88, '2023-05-31', 3, 3),  
(0, 60, '2023-06-01', 4, 4),  
(0, 90, '2023-06-08', 5, 5)
```

End_Query

Initial_database_setup: delete_high_prio_lung_list

Query:

```
DELETE FROM high_prio_lung_list
```

End_Query

Initial_database_setup: insert_high_prio_lung_list

Query:

```
INSERT INTO high_prio_lung_list
```

```
(availability_id, priority, placement_date, patient_id, high_prio_lung_listid)
```

VALUES

```
(1, 90, '2023-06-03', 21, 1),  
(1, 80, '2023-06-04', 22, 2),  
(1, 80, '2023-06-08', 23, 3),  
(0, 80, '2023-05-31', 24, 4),  
(0, 70, '2023-06-08', 25, 5)
```

End_Query

³ For some reason, SQLite generates the fields in a reverse order.

```
Initial_database_setup: update_transplant_center
Query:
UPDATE transplant_center
  SET tc_availability_id = 1
  WHERE transplant_center_id < 4
End_Query
```

The initial situation in the database for 2 test runs

3 patients on the high prio heart list:

```
1 SELECT a.patient_id, b.name, a.priority, a.placement_date
2 FROM high_prio_heart_list AS a
3 JOIN patient AS b ON a.patient_id = b.patientid
4 WHERE availability_id = 1
5 ORDER BY priority DESC,
6 placement_date ASC;
7
```

Grid view Form view

Total rows loaded: 3

	patient id	name	priority	placement date
1	1	Lawrence Peterson	90	2023-05-31
2	2	Jeffrey Miller	90	2023-06-08
3	3	Haley Marshall	88	2023-05-31

3 patients on the high prio lung list:

```
1 SELECT a.patient_id, b.name, a.priority, a.placement_date
2 FROM high_prio_lung_list AS a
3 JOIN patient AS b ON a.patient_id = b.patientid
4 WHERE availability_id = 1
5 ORDER BY priority DESC,
6 placement_date ASC;
7
```

Grid view Form view

Total rows loaded: 3

	patient id	name	priority	placement date
1	21	Travis Carlson	90	2023-06-03
2	22	Elizabeth Alvarez	80	2023-06-04
3	23	Carrie Mullins	80	2023-06-08

3 transplant centers available for an organ offering:

```
1 SELECT transplant_center_id, name, tc_availability_id
2 FROM transplant_center;
3
4
5
```

Grid view Form view

Total rows loaded: 12

	transplant_center_id	name	tc_availability_id
1	1	Medical Center West	1
2	2	Medical Center East	1
3	3	Medical Center North	1

3 organ blocks, containing 3 hearts and 3 lungs available:

```
1 SELECT a.organ_block_id,  
2        b.donorid,  
3        b.name AS donername,  
4        c.status AS heart_status,  
5        d.status AS lung_status,  
6        a.organ_availability_date  
7 FROM organ_block AS a  
8     INNER JOIN  
9     donor AS b ON (a.donorid = b.donorid)  
10    INNER JOIN  
11    organstatus AS c ON (a.heart_status = c.statusid)  
12    INNER JOIN  
13    organstatus AS d ON (a.lung_status = d.statusid)  
14 WHERE c.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined") OR  
15        d.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined")  
16 ORDER BY organ_availability_date ASC;
```

Grid view

Form view

     1    Total rows loaded: 3

	organ block id	donorid	donername	heart status	lung status	organ availability date
1	1	1	Chelsea Smith	I-Available	I-Available	2023-06-05
2	2	2	Rachel Miller	I-Available	I-Available	2023-06-06
3	3	3	James Booth MD	I-Available	I-Available	2023-06-11

Testrun 1

Situation:

3 patients on the high prio heart list
3 patients on the high prio lung list:
3 organ blocks, containing 3 hearts and 3 lungs

Expectation:

The organ blocks are processed in the order: 1,2,3
The hearts are offered to patients in the order: 1,2,3
The lungs are offered to patients in the order: 21,22,23

Check:

```
Offer the heart to patient 1 on the heart prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
Offer the lungs to patient 21 on the lung prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
Offer the heart to patient 2 on the heart prio list
This concerns organ block 2 from donor Rachel Miller.
=====
Offer the lungs to patient 22 on the lung prio list
This concerns organ block 2 from donor Rachel Miller.
=====
Offer the heart to patient 3 on the heart prio list
This concerns organ block 3 from donor James Booth MD.
=====
Offer the lungs to patient 23 on the lung prio list
This concerns organ block 3 from donor James Booth MD.
=====
```

Situation:

2 new organ blocks available, containing 2 hearts and 1 lung:

```
UPDATE organ_block SET heart_status = 1, lung_status = 1 WHERE organ_block_id = 4;
UPDATE organ_block SET heart_status = 1, lung_status = 9 WHERE organ_block_id = 5;
```

4	4	Jacqueline Johnson DDS	I-Available	I-Available	2023-06-05
5	5	Doris Harmon	I-Available	NotAvailable	2023-06-07

Expectation:

No patients on high prio lists available for an organ offer, so offer directly to available tc's.

Check:

```
Offer heart-lung block for the first time to a transplant center:
Medical Center West
This concerns organ block 4 from donor Jacqueline Johnson DDS.
=====
Offer the heart to a next transplant center: Medical Center East
This concerns organ block 5 from donor Doris Harmon.
=====
```

Situation:

Patient 3 and patient 23 decline the organs offered in block 3.

```
UPDATE organ_block SET heart_status = 10,
                    lung_status = 10 WHERE organ_block_id = 3;
```

```
3      3      James Booth MD      I-Declined  I-Declined  2023-06-11
```

Expectation:

No new patients on heart and lung list available, so offer to available TC.

Check:

```
> The heart in the organ block 3 from donor James Booth MD is declined by the patient.
```

```
=====
```

```
> The lungs in the organ block 3 from donor James Booth MD are declined by the patient.
```

```
=====
```

```
Offer heart-lung block for the first time to a transplant center:
```

```
Medical Center North
```

```
This concerns organ block 3 from donor James Booth MD.
```

```
=====
```

Situation:

The TCs are accepting all organs offered so far:

```
UPDATE organ_block SET heart_status = 7, lung_status = 7 WHERE organ_block_id = 4;
```

```
UPDATE organ_block SET heart_status = 7 WHERE organ_block_id = 5;
```

```
UPDATE organ_block SET heart_status = 7, lung_status = 7 WHERE organ_block_id = 3;
```

```
4      4      Jacqueline Johnson DDS      TC-Accepted  TC-Accepted  2023-06-05
5      5      Doris Harmon                  TC-Accepted  NotAvailable  2023-06-07
3      3      James Booth MD                TC-Accepted  TC-Accepted  2023-06-11
```

Expectation:

All organs are assigned to the related TCs, which are then available again for subsequent organ offerings.

Check:

```
The Heart/Lung-block 4 from donor Jacqueline Johnson DDS is assigned to the Transplant Center.
```

```
=====
```

```
The heart in the organ block 5 from donor Doris Harmon is assigned to the Transplant Center.
```

```
=====
```

```
The Heart/Lung-block 3 from donor James Booth MD is assigned to the Transplant Center.
```

```
=====
```

Situation:

The organs in organ blocks 1 and 2 are declined by the respective patients:

```
UPDATE organ_block SET heart_status = 10,
                      lung_status  = 10 WHERE organ_block_id = 1;
UPDATE organ_block SET heart_status = 10,
                      lung_status  = 10 WHERE organ_block_id = 2;
```

1	1	Chelsea Smith	I-Declined	I-Declined	2023-06-05
2	2	Rachel Miller	I-Declined	I-Declined	2023-06-06

Expectation:

Only patients 3 and 23 are available for an organ offer.

So offer the heart in block 1 to patient 3 and offer the lungs in block 1 to patient 23 (because not offered before).

Next, patients 1 and 21 are available for an organ offer.

So offer the heart in block 2 to patient 1 and offer the lungs in block 2 to patient 21 (because not offered before).

Check:

```
> The heart in the organ block 1 from donor Chelsea Smith is declined by the patient.
=====
Offer the heart to patient 3 on the heart prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
> The lungs in the organ block 1 from donor Chelsea Smith are declined by the patient.
=====
Offer the lungs to patient 23 on the lung prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
> The heart in the organ block 2 from donor Rachel Miller is declined by the patient.
=====
Offer the heart to patient 1 on the heart prio list
This concerns organ block 2 from donor Rachel Miller.
=====
> The lungs in the organ block 2 from donor Rachel Miller are declined by the patient.
=====
Offer the lungs to patient 21 on the lung prio list
This concerns organ block 2 from donor Rachel Miller.
=====
```

Situation:

The organs in organ blocks 1 and 2 are declined by the respective patients:

```
UPDATE organ_block SET heart_status = 10,
                        lung_status = 10 WHERE organ_block_id = 1;
UPDATE organ_block SET heart_status = 10,
                        lung_status = 10 WHERE organ_block_id = 2;
```

1	1	Chelsea Smith	I-Declined	I-Declined	2023-06-05
2	2	Rachel Miller	I-Declined	I-Declined	2023-06-06

Expectation:

Only patients 2 and 22 are available for an organ offer.
 So offer the heart in block 1 to patient 2 and offer the lungs in block 1 to patient 22.
 Next, patients 3 and 23 are available for an organ offer.
 So offer the heart in block 2 to patient 3 and offer the lungs in block 2 to patient 23.

Check:

```
> The heart in the organ block 1 from donor Chelsea Smith is declined by the patient.
=====
Offer the heart to patient 2 on the heart prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
> The lungs in the organ block 1 from donor Chelsea Smith are declined by the patient.
=====
Offer the lungs to patient 22 on the lung prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
> The heart in the organ block 2 from donor Rachel Miller is declined by the patient.
=====
Offer the heart to patient 3 on the heart prio list
This concerns organ block 2 from donor Rachel Miller.
=====
> The lungs in the organ block 2 from donor Rachel Miller are declined by the patient.
=====
Offer the lungs to patient 23 on the lung prio list
This concerns organ block 2 from donor Rachel Miller.
=====
```

Situation:

The heart in organ block 1 and lungs in organ block 2 are refused by the patient.

```
UPDATE organ_block SET heart_status = 10 WHERE organ_block_id = 1;
UPDATE organ_block SET lung_status = 10 WHERE organ_block_id = 2;
```

1	1	Chelsea Smith	I-Declined	I-Offered	2023-06-05
2	2	Rachel Miller	I-Offered	I-Declined	2023-06-06

Expectation:

Although patient 1 is available for a heart offer, the declined heart in organ block 1 cannot be offered to this patient because it has been offered before. Thus, the heart in organ block 1 enters a waiting state.

Although patient 21 is available for a lung offer, the declined lungs in organ block 2 cannot be offered to this patient, because this has already happened before. Thus, the lungs in organ block 2 enter a waiting state.

Check:

```
> The heart in the organ block 1 from donor Chelsea Smith is declined by the patient.
=====
The heart is waiting now for a block-offer to a transplant center.
This concerns organ block 1 from donor Chelsea Smith.
=====
> The lungs in the organ block 2 from donor Rachel Miller are declined by the patient.
=====
The lungs are waiting now for a block-offer to a transplant center.
This concerns organ block 2 from donor Rachel Miller.
=====
```

Situation:

The lungs in organ block 1 are declined by the patient (while the heart is in a waiting state).

The heart in organ block 2 is accepted by the patient (while the lungs are in waiting state).

```
UPDATE organ_block SET lung_status = 10 WHERE organ_block_id = 1;
UPDATE organ_block SET heart_status = 3 WHERE organ_block_id = 2;
```

1	1	Chelsea Smith	TC-Wait	I-Declined	2023-06-05
2	2	Rachel Miller	I-Accepted	TC-Wait	2023-06-06

Expectation:

Patients 1 and 21 are available for an organ offer.

The lungs in organ block 1 cannot be offered to patient 21, as this has been done before. Since the heart in organ block 1 is in a waiting state, organ block 1 is now offered as a heart-lung block to an available TC.

The heart in organ block 2 is assigned to the patient, after which the lungs are offered from the waiting state to the next available TC.

Check:

```
> The lungs in the organ block 1 from donor Chelsea Smith are declined by the patient.
=====
Offer heart-lung block for the first time to a transplant center:
Medical Center West
This concerns organ block 1 from donor Chelsea Smith.
=====
The heart in the organ block 2 from donor Rachel Miller is assigned to the patient.
=====
Offer the lungs to a next transplant center: Medical Center East
This concerns organ block 2 from donor Rachel Miller.
=====
```

Test run 1: post-situation in the database

Organ states:

```

1 SELECT a.organ_block_id,
2       b.donorid,
3       b.name AS donorname,
4       c.status AS heart_status,
5       d.status AS lung_status,
6       a.organ_availability_date
7 FROM organ_block AS a
8     INNER JOIN
9     donor AS b ON (a.donorid = b.donorid)
10    INNER JOIN
11    organstatus AS c ON (a.heart_status = c.statusid)
12    INNER JOIN
13    organstatus AS d ON (a.lung_status = d.statusid)
14 --WHERE c.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined") OR
15 --      d.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined")
16 --ORDER BY organ_availability_date ASC;

```

Grid view

Form view










 Total rows loaded: 22

	organ bloc	donorid	donorname	heart status	lung status	organ availab
1	1	1	Chelsea Smith	TC-Offered	TC-Offered	2023-06-05
2	2	2	Rachel Miller	I-Assigned	TC-Offered	2023-06-06
3	3	3	James Booth MD	TC-Assigned	TC-Assigned	2023-06-11
4	4	4	Jacqueline Johnson DDS	TC-Assigned	TC-Assigned	2023-06-05
5	5	5	Doris Harmon	TC-Assigned	NotAvailable	2023-06-07

heart_offer:

	heart_offer_id	organ_block_id	patientid	transplant_center_id	offerdate	responsedate	response_id
1	1	1	1	NULL	2023-10-31 13:02:31.31	2023-10-31 14:02:31	1
2	7	1	3	NULL	2023-10-31 13:31:10.81	2023-10-31 14:31:10	1
3	9	1	2	NULL	2023-10-31 14:45:46.66	2023-10-31 15:45:46	1
4	11	1	NULL	1	2023-10-31 15:11:10.28	NULL	NULL
5	2	2	2	NULL	2023-10-31 13:02:31.45	2023-10-31 14:02:31	1
6	8	2	1	NULL	2023-10-31 13:31:11.00	2023-10-31 14:31:11	1
7	10	2	3	NULL	2023-10-31 14:45:46.92	2023-10-31 15:45:46	2
8	3	3	3	NULL	2023-10-31 13:02:31.53	2023-10-31 14:02:31	1
9	6	3	NULL	3	2023-10-31 13:08:57.99	2023-10-31 14:08:57	2
10	4	4	NULL	1	2023-10-31 13:04:50.70	2023-10-31 14:04:50	2
11	5	5	NULL	2	2023-10-31 13:04:50.76	2023-10-31 14:04:50	2

long_offer:

	lung_offer_id	organ_block	patientid	transplant_center_id	offerdate	responsedate	response_id
1	1	1	21	NULL	2023-10-31 13:02:31.37	2023-10-31 14:02:31	1
2	6	1	23	NULL	2023-10-31 13:31:10.92	2023-10-31 14:31:10	1
3	8	1	22	NULL	2023-10-31 14:45:46.81	2023-10-31 15:45:46	1
4	10	1	NULL	1	2023-10-31 15:11:10.29	NULL	NULL
5	2	2	22	NULL	2023-10-31 13:02:31.49	2023-10-31 14:02:31	1
6	7	2	21	NULL	2023-10-31 13:31:11.10	2023-10-31 14:31:11	1
7	9	2	23	NULL	2023-10-31 14:45:47.07	2023-10-31 15:45:47	1
8	11	2	NULL	2	2023-10-31 15:11:10.37	NULL	NULL
9	3	3	23	NULL	2023-10-31 13:02:31.58	2023-10-31 14:02:31	1
10	5	3	NULL	3	2023-10-31 13:08:58.00	2023-10-31 14:08:58	2
11	4	4	NULL	1	2023-10-31 13:04:50.71	2023-10-31 14:04:50	2

Test run 2

Situation:

3 patients on the high prio heart list
3 patients on the high prio lung list:
3 organ blocks, containing 3 hearts and 3 lungs

Expectation:

The organ blocks are handled in the order: 1,2,3
The hearts are offered to patients in the order: 1,2,3
The lungs are offered to patients in the order: 21,22,23

Check:

```
Offer the heart to patient 1 on the heart prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
Offer the lungs to patient 21 on the lung prio list
This concerns organ block 1 from donor Chelsea Smith.
=====
Offer the heart to patient 2 on the heart prio list
This concerns organ block 2 from donor Rachel Miller.
=====
Offer the lungs to patient 22 on the lung prio list
This concerns organ block 2 from donor Rachel Miller.
=====
Offer the heart to patient 3 on the heart prio list
This concerns organ block 3 from donor James Booth MD.
=====
Offer the lungs to patient 23 on the lung prio list
This concerns organ block 3 from donor James Booth MD.
=====
```

Situation:

All patients decline the organs offered.

```
UPDATE organ_block SET heart_status = 10, lung_status = 10 WHERE organ_block_id =1;
UPDATE organ_block SET heart_status = 10, lung_status = 10 WHERE organ_block_id =2;
UPDATE organ_block SET heart_status = 10, lung_status = 10 WHERE organ_block_id =3;
```

1	1	Chelsea Smith	I-Declined	I-Declined	2023-06-05
2	2	Rachel Miller	I-Declined	I-Declined	2023-06-06
3	3	James Booth MD	I-Declined	I-Declined	2023-06-11

Expectation:

Organ block 1 goes directly to a TC as a heart-lung block because there are no patients available on the high-priority lists.

After this, patients 1 and 21 are available for new organ offerings.

Organs in organ block 2 are offered to these patients.

And patients 2 and 22 are available for new organ offering.

Organs in organ block 3 are offered to these patients.

Check:

```
> The heart in the organ block 1 from donor Chelsea Smith is declined by the patient.
=====
> The lungs in the organ block 1 from donor Chelsea Smith are declined by the patient.
=====
Offer heart-lung block for the first time to a transplant center:
Medical Center West
This concerns organ block 1 from donor Chelsea Smith.
=====
> The heart in the organ block 2 from donor Rachel Miller is declined by the patient.
=====
Offer the heart to patient 1 on the heart prio list
This concerns organ block 2 from donor Rachel Miller.
=====
> The lungs in the organ block 2 from donor Rachel Miller are declined by the patient.
=====
Offer the lungs to patient 21 on the lung prio list
This concerns organ block 2 from donor Rachel Miller.
=====
> The heart in the organ block 3 from donor James Booth MD is declined by the patient.
=====
Offer the heart to patient 2 on the heart prio list
This concerns organ block 3 from donor James Booth MD.
=====
> The lungs in the organ block 3 from donor James Booth MD are declined by the
patient.
=====
Offer the lungs to patient 22 on the lung prio list
This concerns organ block 3 from donor James Booth MD.
=====
```


Situation:

All remaining patients with organ offers decline the offered organs.

```
UPDATE organ_block SET heart_status = 10, lung_status = 10 WHERE organ_block_id =2;
UPDATE organ_block SET heart_status = 10, lung_status = 10 WHERE organ_block_id =3;
```

2	2	Rachel Miller	I-Declined	I-Declined	2023-06-06
3	3	James Booth MD	I-Declined	I-Declined	2023-06-11

Expectation:

Patients 3 and 23 are available for a new organ offering.
Organs in organ block 2 are offered to these patients.
Now patients 1 and 21 are available for new organ offering.
Organs in organ block 3 are offered to these patients.

Check:

```
> The heart in the organ block 2 from donor Rachel Miller is declined by the patient.
=====
Offer the heart to patient 3 on the heart prio list
This concerns organ block 2 from donor Rachel Miller.
=====
> The lungs in the organ block 2 from donor Rachel Miller are declined by the patient.
=====
Offer the lungs to patient 23 on the lung prio list
This concerns organ block 2 from donor Rachel Miller.
=====
> The heart in the organ block 3 from donor James Booth MD is declined by the patient.
=====
Offer the heart to patient 1 on the heart prio list
This concerns organ block 3 from donor James Booth MD.
=====
> The lungs in the organ block 3 from donor James Booth MD are declined by the
patient.
=====
Offer the lungs to patient 21 on the lung prio list
This concerns organ block 3 from donor James Booth MD.
=====
```

Situation:

All remaining patients with organ offers decline the offered organs.

```
UPDATE organ_block SET heart_status = 10, lung_status = 10 WHERE organ_block_id =2;
UPDATE organ_block SET heart_status = 10, lung_status = 10 WHERE organ_block_id =3;
```

2	2	Rachel Miller	I-Declined	I-Declined	2023-06-06
3	3	James Booth MD	I-Declined	I-Declined	2023-06-11

Expectation:

Both organ blocks are now offered as heart-lung blocks to subsequent TCs.

Check:

```
> The heart in the organ block 2 from donor Rachel Miller is declined by the patient.
=====
> The lungs in the organ block 2 from donor Rachel Miller are declined by the patient.
=====
Offer heart-lung block for the first time to a transplant center:
Medical Center East
This concerns organ block 2 from donor Rachel Miller.
=====
> The heart in the organ block 3 from donor James Booth MD is declined by the patient.
=====
> The lungs in the organ block 3 from donor James Booth MD are declined by the
patient.
=====
Offer heart-lung block for the first time to a transplant center:
Medical Center North
This concerns organ block 3 from donor James Booth MD.
=====
```

Situation:

Organ block 1 had been offered as a heart/lung block to TC Medical Center West. No other TCs are currently available for an organ offer. The TC accepts the heart and declines the lungs.

```
UPDATE organ_block SET heart_status = 7, lung_status = 12 WHERE organ_block_id =1;
```

1	1	Chelsea Smith	TC-Accepted	TC-Declined	2023-06-05
---	---	---------------	-------------	-------------	------------

Expectation:

The heart is assigned to the TC; the lungs cannot be offered to a subsequent TC so are given status NotAccepted.

Check:

```
> The lungs in the organ block 1 from donor Chelsea Smith is declined by the
transplant center.
=====
The lungs have not been accepted by patients or transplant centers.
This concerns organ block 1 from donor Chelsea Smith.
=====
The heart in the organ block 1 from donor Chelsea Smith is assigned to the Transplant
Center.
=====
```

Situation:

TC Medical Center West is again available for an organ offer.
Organ block 2 had been offered as a heart/lung block to Medical Center East.
Medical Center East declines both organs in the organ block.

Now Medical Center East is available for an organ offering.
Organ block 3 had been offered as heart/lung block to Medical Center North.
This TC accepts the lungs, and declines the heart.

```
UPDATE organ_block SET heart_status = 12, lung_status = 12 WHERE organ_block_id =2;
UPDATE organ_block SET heart_status = 12, lung_status = 7 WHERE organ_block_id =3;
```

2	2	Rachel Miller	TC-Declined	TC-Declined	2023-06-06
3	3	James Booth MD	TC-Declined	TC-Accepted	2023-06-11

Expectation:

Both organs in organ block 2 are offered to TC Medical Center West.
The lungs in organ block 3 are assigned to Medical Center North.
The heart in organ block 3 is offered to Medical Center East.

Check:

> The Heart/Lung-block 2 from donor Rachel Miller is declined by the transplant center.

=====
Offer heart-lung block to a next transplant center: Medical Center West
This concerns organ block 2 from donor Rachel Miller.

=====
> The heart in the organ block 3 from donor James Booth MD is declined by the transplant center.

=====
Offer the heart to a next transplant center: Medical Center East
This concerns organ block 3 from donor James Booth MD.

=====
The lungs in the organ block 3 from donor James Booth MD are assigned to the Transplant Center.

Situation:

TCs accept the organs offered.

```
UPDATE organ_block SET heart_status = 7, lung_status = 7 WHERE organ_block_id = 2;
UPDATE organ_block SET heart_status = 7 WHERE organ_block_id = 3;
```

2	2	Rachel Miller	TC-Accepted	TC-Accepted	2023-06-06
3	3	James Booth MD	TC-Accepted	TC-Assigned	2023-06-11

Expectation:

Organs are assigned.

Check:

The Heart/Lung-block 2 from donor Rachel Miller is assigned to the Transplant Center.

=====
The heart in the organ block 3 from donor James Booth MD is assigned to the Transplant Center.

=====
No organs to handle anymore.
The organ handling service has been finished

Test run 2: post-situation in the database

Organ states:

```

1 SELECT a.organ_block_id,
2       b.donorid,
3       b.name AS donorname,
4       c.status AS heart_status,
5       d.status AS lung_status,
6       a.organ_availability_date
7 FROM organ_block AS a
8     INNER JOIN
9     donor AS b ON (a.donorid = b.donorid)
10    INNER JOIN
11    organstatus AS c ON (a.heart_status = c.statusid)
12    INNER JOIN
13    organstatus AS d ON (a.lung_status = d.statusid)
14 --WHERE c.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined") OR
15 --      d.status IN ("I-Available", "I-Accepted", "I-Declined", "TC-Accepted", "TC-Declined")
16 --ORDER BY organ_availability_date ASC;

```

Grid view

Form view









 Total rows loaded: 22

	organ bloc	donorid	donorname	heart status	lung status	organ availab
1	1	1	Chelsea Smith	TC-Assigned	NotAccepted	2023-06-05
2	2	2	Rachel Miller	TC-Assigned	TC-Assigned	2023-06-06
3	3	3	James Booth MD	TC-Assigned	TC-Assigned	2023-06-11

heart_offer:

heart_offer_id	organ_block_id	patientid	transplant_center_id	offerdate	respondedate	response_id
1	1	1	NULL	2023-11-01 11:03:48.87	2023-11-01 12:03:48	1
4	1	NULL	1	2023-11-01 11:20:02.51	2023-11-01 12:20:02	2
2	2	2	NULL	2023-11-01 11:03:48.93	2023-11-01 12:03:48	1
5	2	1	NULL	2023-11-01 11:20:02.58	2023-11-01 12:20:02	1
7	2	3	NULL	2023-11-01 11:29:14.50	2023-11-01 12:29:14	1
9	2	NULL	2	2023-11-01 11:33:35.37	2023-11-01 12:33:35	1
11	2	NULL	1	2023-11-01 13:14:35.87	2023-11-01 14:14:35	2
3	3	3	NULL	2023-11-01 11:03:48.99	2023-11-01 12:03:48	1
6	3	2	NULL	2023-11-01 11:20:02.69	2023-11-01 12:20:02	1
8	3	1	NULL	2023-11-01 11:29:14.65	2023-11-01 12:29:14	1
10	3	NULL	3	2023-11-01 11:33:35.46	2023-11-01 12:33:35	1
12	3	NULL	2	2023-11-01 13:14:35.94	2023-11-01 14:14:35	2

lung_offer:

lung_offer_id	organ_block_id	patientid	transplant_center_id	offerdate	respondedate	response_id
1	1	21	NULL	2023-11-01 11:03:48.90	2023-11-01 12:03:48	1
4	1	NULL	1	2023-11-01 11:20:02.52	2023-11-01 12:20:02	1
2	2	22	NULL	2023-11-01 11:03:48.96	2023-11-01 12:03:48	1
5	2	21	NULL	2023-11-01 11:20:02.63	2023-11-01 12:20:02	1
7	2	23	NULL	2023-11-01 11:29:14.59	2023-11-01 12:29:14	1
9	2	NULL	2	2023-11-01 11:33:35.37	2023-11-01 12:33:35	1
11	2	NULL	1	2023-11-01 13:14:35.88	2023-11-01 14:14:35	2
3	3	23	NULL	2023-11-01 11:03:49.02	2023-11-01 12:03:49	1
6	3	22	NULL	2023-11-01 11:20:02.74	2023-11-01 12:20:02	1
8	3	21	NULL	2023-11-01 11:29:14.70	2023-11-01 12:29:14	1
10	3	NULL	3	2023-11-01 11:33:35.46	2023-11-01 12:33:35	2

Appendix: code for Graphviz to generate the State Transition Diagram.

Code present at <https://dreampuf.github.io/GraphvizOnline/>
overwrite with:

```
digraph G {
  "Other application (*)" -> "1. I-Available"
  "Other application (*)" -> "9. NotAvailable"
  "1. I-Available" -> "2. I-Offered" [label= 1]
  "1. I-Available" -> "4. TC-Wait" [label = 3]
  "1. I-Available" -> "5. TC-Available \n(=Single Organ Block)" [label = 2]
  "2. I-Offered" -> "10. I-Declined" [label="*"]
  "10. I-Declined" -> "2. I-Offered" [label= 4]
  "10. I-Declined" -> "4. TC-Wait" [label = 6]
  "10. I-Declined" -> "5. TC-Available \n(=Single Organ Block)" [label = 7]
  "2. I-Offered" -> "3. I-Accepted" [label="*"]
  "3. I-Accepted" -> "11. I-Assigned" [label = 5]
  "4. TC-Wait" -> "5. TC-Available \n(=Single Organ Block)" [label = 8]
  "4. TC-Wait" -> "6. TC-Offered" [label = "9 (Heart-Lung Block)"]
  "4. TC-Wait" -> "8. NotAccepted" [label= 10]
  "5. TC-Available \n(=Single Organ Block)" -> "6. TC-Offered" [label = 11]
  "5. TC-Available \n(=Single Organ Block)" -> "8. NotAccepted" [label= 12]
  "6. TC-Offered" -> "7. TC-Accepted" [label="*"]
  "7. TC-Accepted" -> "13. TC-Assigned" [label= 15]
  "6. TC-Offered" -> "12. TC-Declined" [label="*"]
  "12. TC-Declined" -> "6. TC-Offered" [label= 13]
  "12. TC-Declined" -> "8. NotAccepted" [label= 14]
  "9. NotAvailable" [style="filled", fillcolor="gray"]
  "11. I-Assigned" [style="filled", fillcolor="gray"]
  "13. TC-Assigned" [style="filled", fillcolor="gray"]
  "8. NotAccepted" [style="filled", fillcolor="gray"]
  "1. I-Available" [style="filled", fillcolor="orange"]
  "3. I-Accepted" [style="filled", fillcolor="orange"]
  "10. I-Declined" [style="filled", fillcolor="orange"]
  "7. TC-Accepted" [style="filled", fillcolor="orange"]
  "12. TC-Declined" [style="filled", fillcolor="orange"]
}
```