

# Напредни бази на податоци

## Индекси и оптимизација

### Проект: Paws\_Care\_DB

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#### 1. View no.1 – Review\_stats

- Примарниот филтер за погледот е според owner\_id. Ова го употребуваме за да имаме преглед кој клиент каква оцена има дадено за клиниката.

1.1 Иницијалното време на извршување е 174.994ms. Ова време е прифатливо и нема потреба за индексирање.

```
SELECT * FROM Review_Stats WHERE owner_id = 123;
```

QUERY PLAN	
1	Finalize GroupAggregate (cost=1000.00..41002.36 rows=1 width=76) (actual time=150.172..174.931 rows=1 loops=1)
2	-> Gather (cost=1000.00..41002.33 rows=2 width=76) (actual time=150.125..174.887 rows=3 loops=1)
3	Workers Planned: 2
4	Workers Launched: 2
5	-> Partial GroupAggregate (cost=0.00..40002.13 rows=1 width=76) (actual time=106.311..106.312 rows=1 loops=3)
6	-> Parallel Seq Scan on review (cost=0.00..40002.00 rows=12 width=34) (actual time=8.656..106.277 rows=7 loop
7	Filter: (owner_id = 123)
8	Rows Removed by Filter: 999993
9	Planning Time: 1.050 ms
10	Execution Time: 174.994 ms

1.2 Времето на извршување на insert изнесува 39.493 ms и е задоволително.

```
EXPLAIN ANALYZE  
INSERT INTO Review (review_id, rating, comment, owner_id)  
VALUES (3000001, 5, 'Одлична услуга!', 1);
```

QUERY PLAN	
1	Insert on review (cost=0.00..0.01 rows=0 width=0) (actual time=29.105..29.105 rows=0 loops=1)
2	-> Result (cost=0.00..0.01 rows=1 width=44) (actual time=0.002..0.003 rows=1 loops=1)
3	Planning Time: 0.039 ms
4	Trigger for constraint review_owner_id_fkey: time=10.355 calls=1
5	Execution Time: 39.493 ms

1.3 Времето на извршување на update изнесува 634.076 ms и е задоволително.

```
EXPLAIN ANALYZE
UPDATE Review
SET comment = 'Ажуриран коментар: Сè беше во ред.'
WHERE owner_id = 1;
```

QUERY PLAN	
1	Update on review (cost=0.00..61877.00 rows=0 width=0) (actual time=631.306..631.308 rows=0 l...
2	-> Seq Scan on review (cost=0.00..61877.00 rows=28 width=38) (actual time=18.015..534.704...
3	Filter: (owner_id = 1)
4	Rows Removed by Filter: 2999966
5	Planning Time: 0.082 ms
6	Execution Time: 634.076 ms

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 2. View no.2 - View\_Available\_Veterinarians

- Примарниот филтер за погледот е според shift-типе. Ова го употребуваме за да имаме преглед кој ветеринар е достапен во одредена смена.

2.1 Иницијалното време на извршување е 332.969ms. Ова е прифатливо време и нема потреба од индексирање

```
EXPLAIN (ANALYZE, BUFFERS)
SELECT * FROM View_Available_Veterinarians
WHERE shift_type = 'On-Call';
```

QUERY PLAN	
Buffers: shared hit=500 read=500	
->	Merge Join (cost=0.55..166.89 rows=67 width=47) (actual time=0.043..0.480 rows=200 loops=1)
	Merge Cond: (v.veterinarian_id = mp.medical_prof_id)
	Buffers: shared hit=7 read=19
->	Index Scan using veterinarian_pkey on veterinarian v (cost=0.28..46.27 rows=1000 width=26) (actual time=0.010..0.137 rows=1000 loops=1)
	Buffers: shared hit=5 read=7
->	Index Scan using medical_professional_pkey on medical_professional mp (cost=0.28..234.28 rows=134 width=21) (actual time=0.028..0.255 rows=201)
	Filter: (((shift_type)::text = 'On-Call'::text) AND (((shift_type)::text = 'Morning'::text) AND (EXTRACT(hour FROM now()) >= '6'::numeric) AND (EXTRACT(hour FROM now()) <= '11'::numeric)))
	Rows Removed by Filter: 803
	Buffers: shared hit=2 read=12
->	Index Scan using person_pkey on person per (cost=0.29..4.28 rows=1 width=17) (actual time=0.001..0.001 rows=1 loops=200)
	Index Cond: (person_id = v.veterinarian_id)
	Buffers: shared hit=581 read=19
Planning:	
	Buffers: shared hit=407 read=72
Planning Time: 9.544 ms	
Execution Time: 332.969 ms	

2.2 Времето на извршување на insert изнесува 0.269ms. Тоа време задоволително.

```
EXPLAIN (ANALYZE, BUFFERS)
INSERT INTO Medical_Professional (medical_prof_id, medical_degree, shift_type, department, is_surgical_authorized)
VALUES (102008, 'DVM', 'Morning', 'Surgery', TRUE);
```

```

QUERY PLAN
Insert on medical_professional (cost=0.00..0.01 rows=0 width=0) (actual time=0.121..0.121 rows=0 loops=1)
  Buffers: shared hit=4
  -> Result (cost=0.00..0.01 rows=1 width=399) (actual time=0.001..0.001 rows=1 loops=1)
Planning Time: 0.033 ms
Trigger for constraint medical_professional_medical_prof_id_fkey: time=0.130 calls=1
Execution Time: 0.269 ms

```

2.3 Времето на извршување на update изнесува 1.636 ms. Тоа време е задоволително.

```

EXPLAIN (ANALYZE, BUFFERS)
UPDATE Medical_Professional
SET shift_type = 'On-Call'
WHERE medical_prof_id = 102008;

```

```

QUERY PLAN
Update on medical_professional (cost=0.28..8.29 rows=0 width=0) (actual time=0.192..0.192 rows=0 loops=1)
  Buffers: shared hit=15 read=1 dirtied=1
  -> Index Scan using medical_professional_pkey on medical_professional (cost=0.28..8.29 rows=1 width=64) (actual time=0.018..0.019 rows=1 loops=1)
      Index Cond: (medical_prof_id = 102008)
      Buffers: shared hit=3 dirtied=1
Planning Time: 0.139 ms
Execution Time: 1.636 ms

```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

### 3. View no.3 View\_Free\_Upcoming\_Slots

- Примарниот филтер за погледот е според exam\_room\_id. Ова го употребуваме за да имаме преглед во која соба за преглед е слободна за да се закаже преглед во неа.

3.1 Иницијалното време на извршување е 492.828ms. Ова е прифатливо време.

```

EXPLAIN ANALYZE
SELECT * FROM View_Free_Upcoming_Slots
WHERE exam_room_id = 1;

```

```

QUERY PLAN
Merge Right Anti Join (cost=249312.60..251333.27 rows=960 width=20) (actual time=487.591..492.755 rows=49 loops=1)
  Merge Cond: (ap.appointment_time = ts.slot_time)
  -> Sort (cost=249234.46..250242.10 rows=403054 width=12) (actual time=487.433..492.584 rows=0 loops=1)
      Sort Key: ap.appointment_time
      Sort Method: quicksort Memory: 25kB
      -> Gather (cost=1000.00..204817.40 rows=403054 width=12) (actual time=487.420..492.570 rows=0 loops=1)
          Workers Planned: 2
          Workers Launched: 2
          -> Parallel Seq Scan on appointment ap (cost=0.00..163512.00 rows=167939 width=12) (actual time=458.175..458.175 rows=0 loops=3)
              Filter: ((exam_room_id = 1) AND ((status)::text = 'Scheduled'::text))
              Rows Removed by Filter: 333333
      -> Sort (cost=78.13..80.63 rows=1000 width=20) (actual time=0.155..0.159 rows=49 loops=1)
          Sort Key: ts.slot_time
          Sort Method: quicksort Memory: 26kB
          -> Nested Loop (cost=0.29..28.30 rows=1000 width=20) (actual time=0.052..0.060 rows=49 loops=1)
              -> Index Scan using exam_room_pkey on exam_room er (cost=0.28..8.29 rows=1 width=12) (actual time=0.019..0.020 rows=1 loops=1)
                  Index Cond: (exam_room_id = 1)
                  Filter: is_available
              -> Function Scan on generate_series ts (cost=0.01..10.01 rows=1000 width=8) (actual time=0.026..0.029 rows=49 loops=1)
Planning Time: 1.971 ms
Execution Time: 492.828 ms

```

3.2 Времето на извршување на insert изнесува 40.213ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Appointment (appointment_id, appointment_time, status, exam_room_id) VALUES
(10000001, NOW() + INTERVAL '2 hours', 'Scheduled', 1);
```

```
QUERY PLAN
1 Insert on appointment (cost=0.00..0.02 rows=0 width=0) (actual time=28.065..28.066 rows=0 loops=1)
2   -> Result (cost=0.00..0.02 rows=1 width=500) (actual time=0.007..0.007 rows=1 loops=1)
3 Planning Time: 0.053 ms
4 Trigger for constraint appointment_pet_id_fkey: time=11.548 calls=1
5 Trigger for constraint appointment_exam_room_id_fkey: time=0.487 calls=1
6 Trigger for constraint appointment_receptionist_id_fkey: time=0.080 calls=1
7 Execution Time: 40.213 ms
```

3.3 Времето на извршување на update изнесува 2137.049ms. Тоа време можеме да го подобриме со индекс, бидејќи овој view би бил користен повеќе пати на ден при закажување нови прегледи.

```
EXPLAIN ANALYZE
UPDATE Appointment
SET appointment_time = appointment_time + INTERVAL '30 minutes'
WHERE exam_room_id = 1 AND status = 'Scheduled';
```

```
QUERY PLAN
Update on appointment (cost=0.00..252019.64 rows=0 width=0) (actual time=2136.984..2136.986 rows=...
  -> Seq Scan on appointment (cost=0.00..252019.64 rows=403054 width=14) (actual time=1938.264...
    Filter: ((exam_room_id = 1) AND ((status)::text = 'Scheduled'::text))
    Rows Removed by Filter: 10000000
Planning Time: 0.090 ms
Execution Time: 2137.049 ms
```

За таа цел креираме индекс на собата за преглед, статус на преглед и времето кога тој е закажан.

```
CREATE INDEX idx_appointment_room_time
ON Appointment (exam_room_id, status, appointment_time);
```

3.3 После креирањето на индексот, време за update се намалува од 2137.049ms на 0.244ms.

```
QUERY PLAN
Update on appointment (cost=12127.90..217451.72 rows=0 width=0) (actual time=0.196..0.197 rows=0 loops=1)
  -> Bitmap Heap Scan on appointment (cost=12127.90..217451.72 rows=403058 width=14) (actual time=0.053..0.059 rows=2 loops=1)
    Recheck Cond: ((exam_room_id = 1) AND ((status)::text = 'Scheduled'::text))
    Heap Blocks: exact=2
  -> Bitmap Index Scan on idx_appointment_room_time (cost=0.00..12027.14 rows=403058 width=0) (actual time=0.039..0.039 rows=2 loops=1)
    Index Cond: ((exam_room_id = 1) AND ((status)::text = 'Scheduled'::text))
Planning Time: 0.110 ms
Execution Time: 0.244 ms
```

#### 4. View no.4 View\_Low\_Stock\_Products

- Примарниот филтер за погледот е според product\_id. Ова го употребуваме за да имаме преглед кој продукт треба да го нарачаеме.

4.1 Иницијалното време на извршување е 0.476s. Ова е прифатливо време.

```
EXPLAIN ANALYZE
SELECT *
FROM View_Low_Stock_Products WHERE product_id = 6;
```

```
QUERY PLAN
Index Scan using product_pkey on product (cost=0.28..8.30 rows=1 width=38) (actual time=0.443..0.444 rows=0 loops=1)
  Index Cond: (product_id = 6)
  Filter: (stock_quantity <= reorder_level)
  Rows Removed by Filter: 1
Planning Time: 3.163 ms
Execution Time: 0.476 ms
```

4.2 Времето на извршување на insert изнесува 1.434ms. Времето е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Product (product_id, name, manufacturer, stock_quantity, unit_price, reorder_level,
inventory_manager_id)
VALUES (1501, 'Aspirin', 'Pfizer', 100, 5.50, 15, 100003);
```

```
QUERY PLAN
Insert on product (cost=0.00..0.01 rows=0 width=0) (actual time=0.083..0.083 rows=0 loops=1)
  -> Result (cost=0.00..0.01 rows=1 width=501) (actual time=0.001..0.001 rows=1 loops=1)
Planning Time: 0.024 ms
Trigger for constraint product_inventory_manager_id_fkey: time=1.331 calls=1
Execution Time: 1.434 ms
```

4.3 Времето на извршување на update изнесува 0.237ms. Времето е задоволително.

```
EXPLAIN ANALYZE
UPDATE Product
SET stock_quantity = stock_quantity - 2
WHERE product_id = 6;
```

```
QUERY PLAN
Update on product (cost=0.28..8.30 rows=0 width=0) (actual time=0.185..0.185 rows=0 loops=1)
  -> Index Scan using product_pkey on product (cost=0.28..8.30 rows=1 width=10) (actual time=0.010..0.011 rows=1 loops=1)
    Index Cond: (product_id = 6)
Planning Time: 0.101 ms
Execution Time: 0.237 ms
```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 5. View no. 5 View\_Medical\_Staff\_Dashboard

- Примарниот филтер за погледот е според today\_appointments. Ова го употребуваме за да имаме преглед кој доктори во текот на денот имаат закажани прегледи.

5.1 Иницијалното време на извршување е 1414.738ms. Времето е прифатливо и нема потреба од индексирање

```
EXPLAIN ANALYZE
SELECT *
FROM View_Medical_Staff_Dashboard WHERE today_appointments != 0;
```

```
QUERY PLAN
-> Gather Merge (cost=308835.16..309357.29 rows=4000 width=12) (actual time=727.128..729.225 rows=6 loops=1)
    Workers Planned: 2
    Workers Launched: 2
-> Partial GroupAggregate (cost=307835.14..307895.57 rows=2000 width=12) (actual time=670.519..670.521 rows=2 loops=3)
    Group Key: a_link.medical_prof_id
-> Sort (cost=307835.14..307848.61 rows=5391 width=8) (actual time=670.516..670.517 rows=2 loops=3)
    Sort Key: a_link.medical_prof_id
    Sort Method: quicksort Memory: 25kB
    Worker 0: Sort Method: quicksort Memory: 25kB
    Worker 1: Sort Method: quicksort Memory: 25kB
-> Parallel Hash Join (cost=184399.41..307500.99 rows=5391 width=8) (actual time=538.868..670.482 rows=2 loops=3)
    Hash Cond: (a_link.app_id = a.appointment_id)
-> Parallel Seq Scan on attends a_link (cost=0.00..109206.52 rows=5293352 width=8) (actual time=0.461..157.582 rows=423468)
-> Parallel Hash (cost=184346.36..184346.36 rows=4244 width=4) (actual time=274.541..274.541 rows=1 loops=3)
    Buckets: 16384 Batches: 1 Memory Usage: 160kB
-> Parallel Seq Scan on appointment a (cost=0.00..184346.36 rows=4244 width=4) (actual time=166.432..274.453 rows=1)
    Filter: (((status)::text = 'Scheduled'::text) AND ((appointment_time)::date = CURRENT_DATE))
    Rows Removed by Filter: 3333334
Planning Time: 12.936 ms
Execution Time: 1414.738 ms
```

5.2 Времето на извршување на insert во Appointment изнесува 43.275ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Appointment (appointment_id, appointment_time, status, reason, pet_id) VALUES
(10000005, '2026-05-20 10:30:00', 'Scheduled', 'Рутински преглед', 1);
```

```
QUERY PLAN
Insert on appointment (cost=0.00..0.01 rows=0 width=0) (actual time=30.452..30.453 rows=0 loops=1)
-> Result (cost=0.00..0.01 rows=1 width=500) (actual time=0.001..0.002 rows=1 loops=1)
Planning Time: 0.034 ms
Trigger for constraint appointment_pet_id_fkey: time=12.536 calls=1
Trigger for constraint appointment_exam_room_id_fkey: time=0.204 calls=1
Trigger for constraint appointment_receptionist_id_fkey: time=0.048 calls=1
Execution Time: 43.275 ms
```

5.2.1 Времето на извршување на insert во Attends изнесува 0.830ms. Тоа време е задоволително

```
EXPLAIN ANALYZE
INSERT INTO Attends (medical_prof_id, app_id)
VALUES (100017, 10000005);
```

```
QUERY PLAN
Insert on attends (cost=0.00..0.01 rows=0 width=0) (actual time=0.539..0.539 rows=0 loops=1)
  -> Result (cost=0.00..0.01 rows=1 width=8) (actual time=0.001..0.001 rows=1 loops=1)
Planning Time: 0.014 ms
Trigger for constraint attends_medical_prof_id_fkey: time=0.130 calls=1
Trigger for constraint attends_app_id_fkey: time=0.143 calls=1
Execution Time: 0.830 ms
```

5.3 Времето на извршување на update изнесува 1.581ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
UPDATE Appointment
SET status = 'Cancelled'
WHERE appointment_id = 10000005;
```

```
QUERY PLAN
Update on appointment (cost=0.43..8.45 rows=0 width=0) (actual time=0.789..0.789 rows=0 loops=1)
  -> Index Scan using appointment_pkey on appointment (cost=0.43..8.45 rows=1 width=64) (actual time=0.105..0.107 rows=1 loops=1)
      Index Cond: (appointment_id = 10000005)
Planning Time: 4.086 ms
Execution Time: 1.581 ms
```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 6. View no. 6 – View\_Next\_Appointments

- Примарниот филтер за погледот е според owner\_id. Ова го употребуваме за клиентот да има преглед кога е наредниот закажан темрин за неговото милениче.

6.1 Иницијалното време на извршување е 990.259ms. Ова е прифатливо време и нема потреба од индексирање.

```
EXPLAIN ANALYZE
SELECT * FROM View_Next_Appointments
WHERE owner_id = 1001 ORDER BY appointment_time ASC;
```

```
Filter: (owner_id = 1001)
Rows Removed by Filter: 333331
-> Index Scan using pet_pkey on pet p (cost=0.29..0.31 rows=1 width=9) (actual time=0.061..0.061 rows=1 loops=120)
    Index Cond: (pet_id = a.pet_id)
-> Memoize (cost=0.29..0.30 rows=1 width=12) (actual time=0.001..0.001 rows=1 loops=120)
    Cache Key: a.exam_room_id
    Cache Mode: logical
    Hits: 19 Misses: 1 Evictions: 0 Overflows: 0 Memory Usage: 1kB
    Worker 0: Hits: 59 Misses: 1 Evictions: 0 Overflows: 0 Memory Usage: 1kB
    Worker 1: Hits: 39 Misses: 1 Evictions: 0 Overflows: 0 Memory Usage: 1kB
-> Index Scan using exam_room_pkey on exam_room er (cost=0.28..0.29 rows=1 width=12) (actual time=0.027..0.028 rows=1 loops=1)
    Index Cond: (exam_room_id = a.exam_room_id)
-> Hash (cost=18.00..18.00 rows=1000 width=15) (actual time=0.692..0.693 rows=1000 loops=3)
    Buckets: 1024 Batches: 1 Memory Usage: 55kB
-> Seq Scan on veterinarian vt (cost=0.00..18.00 rows=1000 width=15) (actual time=0.428..0.541 rows=1000 loops=3)
-> Index Scan using person_pkey on person per_doc (cost=0.29..4.28 rows=1 width=17) (actual time=0.001..0.001 rows=0 loops=160)
    Index Cond: (person_id = vt.veterinarian_id)
Planning Time: 1.492 ms
Execution Time: 990.259 ms
```

6.2 Времето на извршување на insert во Appointment изнесува 0.398ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Appointment (appointment_id, appointment_time, reason, status, pet_id, exam_room_id) VALUES
(10000007, NOW()) + INTERVAL '5 days', 'Check up', 'Scheduled', 1, 1);
```

```
QUERY PLAN
Insert on appointment (cost=0.00..0.02 rows=0 width=0) (actual time=0.124..0.125 rows=0 loops=1)
-> Result (cost=0.00..0.02 rows=1 width=500) (actual time=0.015..0.016 rows=1 loops=1)
Planning Time: 0.030 ms
Trigger for constraint appointment_pet_id_fkey: time=0.184 calls=1
Trigger for constraint appointment_exam_room_id_fkey: time=0.071 calls=1
Trigger for constraint appointment_receptionist_id_fkey: time=0.003 calls=1
Execution Time: 0.398 ms
```

6.3 Времето на извршување на update изнесува 1906.084ms. Тоа време е задоволително

```
EXPLAIN ANALYZE
UPDATE Appointment
SET appointment_time = appointment_time + INTERVAL '2 hours'
WHERE pet_id = 1 AND status = 'Scheduled' AND appointment_time >= CURRENT_TIMESTAMP;
```

```
QUERY PLAN
Update on appointment (cost=0.00..301015.12 rows=0 width=0) (actual time=1906.065..1906.065 rows=0 loops=1)
-> Seq Scan on appointment (cost=0.00..301015.12 rows=49 width=14) (actual time=1905.698..1905.702 rows=3 loops=1)
    Filter: ((pet_id = 1) AND ((status)::text = 'Scheduled'::text) AND (appointment_time >= CURRENT_TIMESTAMP))
    Rows Removed by Filter: 10000000
Planning Time: 0.078 ms
Execution Time: 1906.084 ms
```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 7. View no. 7 - View\_Owner\_Financial\_Status

- Примарниот филтер за погледот е според balance. Ова го употребуваме за да имаме преглед кој клиент и должи пари на клиниката.

7.1 Иницијалното време на извршување е 8.210ms. Ова време е прифатливо и нема потреба од индексирање.

```
EXPLAIN ANALYZE
SELECT * FROM View_Owner_Financial_Status
WHERE balance < -500;
```

```
QUERY PLAN
Nested Loop (cost=0.29..2037.28 rows=10 width=118) (actual time=8.191..8.192 rows=0 loops=1)
-> Seq Scan on owner o (cost=0.00..1954.00 rows=10 width=22) (actual time=8.190..8.190 rows=0 loops=1)
    Filter: (balance < '-500'::numeric)
    Rows Removed by Filter: 100000
-> Index Scan using person_pkey on person p (cost=0.29..8.31 rows=1 width=17) (never executed)
    Index Cond: (person_id = o.owner_id)
Planning Time: 0.219 ms
Execution Time: 8.210 ms
```

7.2 Времето на извршување на insert изнесува 12.072ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Owner (owner_id, membership_type, balance, total_spent)
VALUES (100001, 'Standard', 0.00, 0.00);
```

```
QUERY PLAN
Insert on owner (cost=0.00..0.01 rows=0 width=0) (actual time=11.764..11.765 rows=0 loops=1)
-> Result (cost=0.00..0.01 rows=1 width=74) (actual time=0.001..0.002 rows=1 loops=1)
Planning Time: 0.044 ms
Trigger for constraint owner_owner_id_fkey: time=0.289 calls=1
Execution Time: 12.072 ms
```

7.3 Времето на извршување на update изнесува 7.133ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
UPDATE Owner
SET balance = balance - 200
WHERE balance < -500;
```

```
QUERY PLAN
Update on owner (cost=0.00..1954.05 rows=0 width=0) (actual time=7.098..7.099 rows=0 loops=1)
-> Seq Scan on owner (cost=0.00..1954.05 rows=10 width=22) (actual time=7.096..7.096 rows=0 loops=1)
    Filter: (balance < '-500'::numeric)
    Rows Removed by Filter: 100001
Planning Time: 0.062 ms
Execution Time: 7.133 ms
```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 8. View no. 8 -View\_Owner\_Pet\_Treatments

- Примарниот филтер за погледот е според owner\_id. Ова го употребуваме за клиентот да може да ја види историјата на прегледи на неговото милениче.

8.1 Иницијалното време на извршување е 701.853ms. Ова е прифатливо време и нема потреба од индексирање.

```
EXPLAIN ANALYZE
SELECT * FROM View_Owner_Pet_Treatments
WHERE owner_id = 1004
AND treatment_date >= '2026-05-01 00:00:00'
AND treatment_date < '2026-06-01 00:00:00';
```

```
QUERY PLAN
-> Nested Loop (cost=143746.77..190224.06 rows=2 width=24) (actual time=631.052..631.053 rows=0 loops=3)
    -> Parallel Hash Join (cost=143746.34..184058.11 rows=13625 width=16) (actual time=235.440..357.166 rows=11523 loops=3)
        Hash Cond: (mr.medical_record_id = pt.medical_record_id)
        -> Parallel Seq Scan on medical_record mr (cost=0.00..36088.33 rows=833333 width=8) (actual time=0.942..48.380 rows=66667 loo...)
        -> Parallel Hash (cost=143576.03..143576.03 rows=13625 width=16) (actual time=234.346..234.346 rows=11523 loops=3)
            Buckets: 65536 (originally 32768) Batches: 1 (originally 1) Memory Usage: 2464kB
            -> Parallel Seq Scan on performed_treatment pt (cost=0.00..143576.03 rows=13625 width=16) (actual time=43.489..229.690 r...)
                Filter: ((start_time >= '2026-05-01 00:00:00'::timestamp without time zone) AND (start_time < '2026-06-01 00:00:00'::...))
                Rows Removed by Filter: 3321812
        -> Index Only Scan using owner_pet_pair_pkey on owner_pet_pair opp (cost=0.42..0.45 rows=1 width=8) (actual time=0.024..0.024 rows=0...)
            Index Cond: ((pet_id = mr.pet_id) AND (owner_id = 1005))
            Heap Fetches: 0
        -> Index Scan using pet_pkey on pet (cost=0.29..0.31 rows=1 width=15) (never executed)
            Index Cond: (pet_id = mr.pet_id)
        -> Index Scan using treatment_pkey on treatment t (cost=0.43..3.40 rows=1 width=26) (never executed)
            Index Cond: (treatment_id = pt.treatment_id)
Planning Time: 13.973 ms
Execution Time: 701.853 ms
```

8.2 Времето на извршување на insert изнесува 4.141ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Performed_Treatment (performed_treatment_id, start_time, end_time, medical_record_id, treatment_id,
medical_professional_id, exam_room_id)
VALUES (10000007, '2026-05-19 10:00:00', '2026-05-19 11:00:00', 1, 1, 100012, 1);
```

```

QUERY PLAN
Insert on performed_treatment (cost=0.00..0.01 rows=0 width=0) (actual time=0.075..0.075 rows=0 loops=1)
  -> Result (cost=0.00..0.01 rows=1 width=36) (actual time=0.002..0.002 rows=1 loops=1)
Planning Time: 0.017 ms
Trigger for constraint performed_treatment_medical_record_id_fkey: time=1.069 calls=1
Trigger for constraint performed_treatment_treatment_id_fkey: time=0.135 calls=1
Trigger for constraint performed_treatment_medical_professional_id_fkey: time=1.759 calls=1
Trigger for constraint performed_treatment_exam_room_id_fkey: time=1.081 calls=1
Execution Time: 4.141 ms

```

8.3 Времето на извршување на update изнесува 1506.822ms. Тоа време е задоволително.

```

EXPLAIN ANALYZE
UPDATE Performed_Treatment
SET exam_room_id = 5
WHERE medical_record_id = 11
  AND start_time >= '2026-05-01 00:00:00'
  AND start_time < '2026-06-01 00:00:00';

```

```

QUERY PLAN
Update on performed_treatment (cost=0.00..256076.09 rows=0 width=0) (actual time=1505.140..1505.141 rows=0 loops=1)
  -> Seq Scan on performed_treatment (cost=0.00..256076.09 rows=1 width=10) (actual time=1505.139..1505.139 rows=0 loops=1)
        Filter: ((start_time >= '2026-05-01 00:00:00'::timestamp without time zone) AND (start_time < '2026-06-01 00:00:00'::timestamp without time zone) AND (medical_rec...
        Rows Removed by Filter: 10000006
Planning Time: 0.091 ms
Execution Time: 1506.822 ms

```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 9. View no. 9 - View\_Pet\_Owners

- Примарниот филтер за погледот е според pet\_id и is\_primary\_owner. Ова го употребуваме за да имаме увид кој е primary\_owner на миленичето.

9.1 Иницијалното време на извршување е 0.576ms. Ова е прифатливо време.

```

EXPLAIN ANALYZE
SELECT *
FROM View_Pet_Owners
WHERE pet_id = 5 AND is_primary_owner = true;

```

```

QUERY PLAN
Nested Loop (cost=5.39..64.13 rows=1 width=73) (actual time=0.454..0.546 rows=1 loops=1)
  Join Filter: (opp.owner_id = o.owner_id)
  -> Nested Loop (cost=5.09..63.79 rows=1 width=68) (actual time=0.094..0.186 rows=1 loops=1)
        -> Index Scan using pet_pkey on pet p (cost=0.29..8.31 rows=1 width=24) (actual time=0.007..0.009 rows=1 loops=1)
              Index Cond: (pet_id = 5)
        -> Bitmap Heap Scan on owner_pet_pair opp (cost=4.51..47.16 rows=1 width=9) (actual time=0.067..0.156 rows=1 loops=1)
              Recheck Cond: (pet_id = 5)
              Filter: is_primary_owner
              Rows Removed by Filter: 7
              Heap Blocks: exact=8
        -> Bitmap Index Scan on owner_pet_pair_pkey (cost=0.00..4.51 rows=1 width=0) (actual time=0.021..0.022 rows=8 loops=1)
              Index Cond: (pet_id = 5)
  -> Index Scan using person_pkey on person pers (cost=0.29..8.31 rows=1 width=29) (actual time=0.018..0.018 rows=1 loops=1)
        Index Cond: (person_id = opp.owner_id)
  -> Index Only Scan using owner_pkey on owner o (cost=0.29..0.32 rows=1 width=4) (actual time=0.356..0.356 rows=1 loops=1)
        Index Cond: (owner_id = pers.person_id)
        Heap Fetches: 0
Planning Time: 0.522 ms
Execution Time: 0.576 ms

```

9.2 Времето на извршување на insert изнесува 0.742ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Owner_Pet_Pair (owner_id, pet_id, is_primary_owner)
VALUES (100002, 100001, true);
```

```
QUERY PLAN
Insert on owner_pet_pair (cost=0.00..0.01 rows=0 width=0) (actual time=0.034..0.034 rows=0 loops=1)
-> Result (cost=0.00..0.01 rows=1 width=9) (actual time=0.001..0.001 rows=1 loops=1)
Planning Time: 0.015 ms
Trigger for constraint owner_pet_pair_pet_id_fkey: time=0.654 calls=1
Trigger for constraint owner_pet_pair_owner_id_fkey: time=0.043 calls=1
Execution Time: 0.742 ms
```

9.3 Времето на извршување на update изнесува 141.757ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
UPDATE Owner_Pet_Pair
SET is_primary_owner = false
WHERE pet_id = 5 AND is_primary_owner = true;
```

```
QUERY PLAN
Update on owner_pet_pair (cost=4.51..47.16 rows=0 width=0) (actual time=141.684..141.685 rows=0 loops=1)
-> Bitmap Heap Scan on owner_pet_pair (cost=4.51..47.16 rows=1 width=7) (actual time=0.031..0.048 rows=1 loops=1)
    Recheck Cond: (pet_id = 5)
    Filter: is_primary_owner
    Rows Removed by Filter: 7
    Heap Blocks: exact=8
-> Bitmap Index Scan on owner_pet_pair_pkey (cost=0.00..4.51 rows=11 width=0) (actual time=0.021..0.022 rows=8 loops=1)
    Index Cond: (pet_id = 5)
Planning Time: 0.087 ms
Execution Time: 141.757 ms
```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 10. View no. 10 - View\_Stock\_Health

- Примарниот филтер за погледот е според manufacturer и stock\_status. Ова го употребуваме за да имаме увид кои продукти од одредена фирма треба да ги нарачаме.

10.1 Иницијалното време на извршување е 0.264ms. Ова е прифатливо време.

```
EXPLAIN ANALYZE
SELECT * FROM View_Stock_Health
WHERE manufacturer = 'Pet Naturals' AND stock_status IN ('Out of Stock', 'Low Stock');
```

```
-> Index Scan using person_pkey on person p (cost=0.29..8.31 rows=1 width=17) (never executed)
    Index Cond: (person_id = pr.inventory_manager_id)
-> Index Only Scan using inventory_manager_pkey on inventory_manager im (cost=0.15..0.17 rows=1 width=4) (never executed)
    Index Cond: (inventory_manager_id = p.person_id)
    Heap Fetches: 0
Planning Time: 2.973 ms
Execution Time: 0.264 ms
```

10.2 Времето на извршување на insert изнесува 0.351ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
```

```
INSERT INTO Product (product_id, name, manufacturer, stock_quantity, reorder_level, unit_price,  
is_prescription_required, inventory_manager_id)  
VALUES (1502, 'Vitamin B12', 'Bayer', 5, 10, 500.00, false, 100003);
```

```
QUERY PLAN
```

```
Insert on product (cost=0.00..0.01 rows=0 width=0) (actual time=0.132..0.132 rows=0 loops=1)
```

```
-> Result (cost=0.00..0.01 rows=1 width=501) (actual time=0.001..0.001 rows=1 loops=1)
```

```
Planning Time: 0.042 ms
```

```
Trigger for constraint product_inventory_manager_id_fkey: time=0.202 calls=1
```

```
Execution Time: 0.351 ms
```

10.3 Времето на извршување на update изнесува 0.181ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
```

```
UPDATE Product
```

```
SET unit_price = 1500.00
```

```
WHERE product_id = 1502;
```

```
QUERY PLAN
```

```
Update on product (cost=0.28..8.29 rows=0 width=0) (actual time=0.094..0.094 rows=0 loops=1)
```

```
-> Index Scan using product_pkey on product (cost=0.28..8.29 rows=1 width=22) (actual time=0.032..0.033 rows=1 loops=1)
```

```
Index Cond: (product_id = 1502)
```

```
Planning Time: 0.127 ms
```

```
Execution Time: 0.181 ms
```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти.

## 11. View no. 11 – View\_Pet\_Vaccination\_Status

- Примарниот филтер за погледот е според pet\_id и next\_due\_date. Ова го употребуваме за да имаме увид кога е наредна вакцинација на одредено милениче.

11.1 Иницијалното време на извршување е 365.921ms. Ова време е прифатливо.

```
EXPLAIN ANALYZE
SELECT * FROM View_Pet_Vaccination_Status
WHERE pet_id = 100001 AND next_due_date < CURRENT_DATE;
```

```
Hash Cond: (vv.vaccination_id = pt.performed_treatment_id)
-> Parallel Seq Scan on vaccination_vaccine vv (cost=0.00..9572.67 rows=416667 width=8) (never executed)
-> Parallel Hash (cost=38429.07..38429.07 rows=44 width=8) (actual time=299.415..299.416 rows=0 loops=3)
    Buckets: 1024 Batches: 1 Memory Usage: 0KB
    -> Nested Loop (cost=0.43..38429.07 rows=44 width=8) (actual time=298.938..298.939 rows=0 loops=3)
        -> Parallel Seq Scan on medical_record mr (cost=0.00..38171.67 rows=9 width=8) (actual time=298.937..298.937 rows=0 loops=3)
            Filter: (pet_id = 100001)
            Rows Removed by Filter: 666667
        -> Index Scan using idx_treatment_owner_month on performed_treatment pt (cost=0.43..28.54 rows=6 width=8) (never executed)
            Index Cond: (medical_record_id = mr.medical_record_id)
    -> Index Scan using vaccination_pkey on vaccination vacc (cost=0.43..0.46 rows=1 width=12) (never executed)
        Index Cond: (vaccination_id = pt.performed_treatment_id)
        Filter: (next_due_date < CURRENT_DATE)
    -> Index Scan using vaccine_pkey on vaccine_v_info (cost=0.28..0.29 rows=1 width=21) (never executed)
        Index Cond: (vaccine_id = vv.vaccine_id)
Planning Time: 54.034 ms
Execution Time: 365.921 ms
```

11.2 Времето на извршување на insert изнесува 19.606ms. Тоа време е задоволително.

```
-- 1. Внесуваме третман
EXPLAIN ANALYZE
INSERT INTO Performed_Treatment (performed_treatment_id, start_time, end_time, medical_record_id, treatment_id,
medical_professional_id, exam_room_id)
VALUES (10000004, '2026-05-19 11:50:00', '2026-05-19 12:05:00', 1, 1, 102007, 1);

-- 2. Го тестираме внесот во Vaccination
EXPLAIN ANALYZE
INSERT INTO Vaccination (vaccination_id, date, next_due_date)
```

```
QUERY PLAN
Insert on vaccination (cost=0.00..0.01 rows=0 width=0) (actual time=19.373..19.373 rows=0 loops=1)
-> Result (cost=0.00..0.01 rows=1 width=12) (actual time=0.002..0.002 rows=1 loops=1)
Planning Time: 0.048 ms
Trigger for constraint vaccination_vaccination_id_fkey: time=0.215 calls=1
Execution Time: 19.606 ms
```

11.3 Времето на извршување на update изнесува 0.159ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
UPDATE Vaccination
  SET next_due_date='2027-05-20'
WHERE vaccination_id=10000004;
```

```
QUERY PLAN
Update on vaccination (cost=0.43..8.45 rows=0 width=0) (actual time=0.088..0.088 rows=0 loops=1)
  -> Index Scan using vaccination_pkey on vaccination (cost=0.43..8.45 rows=1 width=10) (actual time=0.020..0.021 rows=1 loops=1)
      Index Cond: (vaccination_id = 10000004)
Planning Time: 0.077 ms
Execution Time: 0.159 ms
```

Нема потреба да го преуредуваме прашалникот, времињата на операциите остануваат исти

## 12. View no 12 -View\_treatment\_revenue\_summary

- Примарниот филтер за погледот е според treatment\_name. Ова го употребуваме за да имаме увид кој третман е нај профитабилен.

12.1 Иницијалното време на извршување е 619.249ms. Ова е прифатливо.

```
EXPLAIN ANALYZE
SELECT * FROM View treatment revenue summary
WHERE treatment_name = 'TRT-13-6F96';
```

```
QUERY PLAN
Sort (cost=134688.95..134688.95 rows=1 width=88) (actual time=603.779..619.162 rows=1 loops=1)
  Sort Key: (sum(t.price)) DESC
  Sort Method: quicksort Memory: 25kB
  -> Finalize GroupAggregate (cost=1008.46..134688.94 rows=1 width=88) (actual time=603.768..619.150 rows=1 loops=1)
      -> Gather (cost=1008.46..134688.90 rows=2 width=88) (actual time=603.496..619.114 rows=2 loops=1)
          Workers Planned: 2
          Workers Launched: 2
          -> Partial GroupAggregate (cost=8.46..133688.70 rows=1 width=88) (actual time=576.554..576.558 rows=1 loops=3)
              -> Hash Join (cost=8.46..133688.68 rows=2 width=26) (actual time=458.121..576.535 rows=1 loops=3)
                  Hash Cond: (pt.treatment_id = t.treatment_id)
                  -> Parallel Seq Scan on performed_treatment pt (cost=0.00..122742.69 rows=4166669 width=8) (actual time=0.275..285.206 rows=3333335 loops=3)
                  -> Hash (cost=8.45..8.45 rows=1 width=26) (actual time=0.413..0.414 rows=1 loops=3)
                      Buckets: 1024 Batches: 1 Memory Usage: 9kB
                      -> Index Scan using unique_treatment_name on treatment t (cost=0.43..8.45 rows=1 width=26) (actual time=0.398..0.400 rows=1 loops=3)
                          Index Cond: ((name)::text = 'TRT-13-6F96')::text)
Planning Time: 10.804 ms
Execution Time: 619.249 ms
```

12.2 Времето на извршување на insert изнесува 0.736ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
INSERT INTO Performed_Treatment (performed_treatment_id, start_time, end_time, medical_record_id, treatment_id,
medical_professional_id, exam_room_id)
VALUES(10000009, '2026-05-19 13:00:00', '2026-05-19 13:30:00', 10, 5, 102007, 1);
```

```
QUERY PLAN
Insert on performed_treatment (cost=0.00..0.01 rows=0 width=0) (actual time=0.327..0.328 rows=0 loops=1)
-> Result (cost=0.00..0.01 rows=1 width=36) (actual time=0.001..0.002 rows=1 loops=1)
Planning Time: 0.026 ms
Trigger for constraint performed_treatment_medical_record_id_fkey: time=0.165 calls=1
Trigger for constraint performed_treatment_treatment_id_fkey: time=0.069 calls=1
Trigger for constraint performed_treatment_medical_professional_id_fkey: time=0.101 calls=1
Trigger for constraint performed_treatment_exam_room_id_fkey: time=0.051 calls=1
Execution Time: 0.736 ms
```

12.3 Времето на извршување на update изнесува 16.496ms. Тоа време е задоволително.

```
EXPLAIN ANALYZE
UPDATE Treatment
SET price = 2500.00
WHERE name = 'TRT-13-6F96';
```

```
QUERY PLAN
Update on treatment (cost=0.43..8.45 rows=0 width=0) (actual time=16.447..16.448 rows=0 loops=1)
-> Index Scan using unique_treatment_name on treatment (cost=0.43..8.45 rows=1 width=22) (actual time=0.029..0.033 rows=1 loops=1)
    Index Cond: ((name)::text = 'TRT-13-6F96')::text
Planning Time: 0.115 ms
Execution Time: 16.496 ms
```