

Information Systems and Databases

**Report 2nd Project Assignment**

**Health care center database**

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1. **Create the database**

**create table** Patient

(patient\_number **varchar**(255),

patient\_name **varchar**(255),

birthday **date**,

address **varchar**(255),

**primary key**(patient\_number));

**create table** Doctor

(patient\_number **varchar**(255),

doctor\_id **varchar**(255),

**primary key**(doctor\_id),

**foreign key** (patient\_number) **references** Patient(patient\_number));

**create table** Device

(serialnum **varchar**(255),

manufacturer **varchar**(255),

model **varchar**(255),

**primary key**(serialnum, manufacturer));

**create table** Sensor

(serialnum **varchar**(255),

manufacturer **varchar**(255),

units **varchar**(255),

**primary key**(serialnum, manufacturer),

**foreign key**(serialnum, manufacturer) **references** Device(serialnum, manufacturer));

**create table** Reading

(serialnum **varchar**(255),

manufacturer **varchar**(255),

read\_datetime **timestamp**,

value **float(10,2)**,

**primary key**(serialnum, manufacturer, read\_datetime),

**foreign key**(serialnum, manufacturer) **references** Sensor(serialnum, manufacturer));

**create table** Period

(start\_date **timestamp**,

end\_date **timestamp**,

**primary key**(start\_date, end\_date));

**create table** Wears

(start\_date **timestamp**,

end\_date **timestamp**,

patient\_number **varchar**(255),

serialnum **varchar**(255),

manufacturer **varchar**(255),

**primary key**(start\_date, end\_date, patient\_number),

**foreign key**(start\_date, end\_date**) references** Period(start\_date, end\_date),

**foreign key**(patient\_number) **references** Patient(patient\_number),

**foreign key**(serialnum, manufacturer) **references** Device(serialnum, manufacturer));

**create table** Request

(request\_number **int(10) UNSIGNED**,

patient\_number **varchar**(255),

doctor\_id **varchar**(255),

request\_date **date**,

**primary key**(request\_number),

**foreign key**(patient\_number) **references** Patient(patient\_number),

**foreign key**(doctor\_id) **references** Doctor(doctor\_id));

**create table** Study

(request\_number **int(10) UNSIGNED**,

description **varchar**(255),

study\_date **date**,

doctor\_id **varchar**(255),

manufacturer **varchar**(255),

serialnum **varchar**(255),

**primary key**(request\_number, description),

**foreign key**(request\_number) **references** Request(request\_number),

**foreign key**(doctor\_id) **references** Doctor(doctor\_id),

**foreign key**(serialnum, manufacturer) **references** Device(serialnum, manufacturer));

**create table** Series

(series\_id **int(10) UNSIGNED**,

series\_name **varchar(255),**

base\_url **varchar(255),**

request\_number **int(10) UNSIGNED**,

description **varchar**(255),

**primary key**(series\_id),

**foreign key**(request\_number, description) **references** Study(request\_number, description));

**create table** Element

(series\_id **int(10) UNSIGNED**,

elem\_index **int(10) UNSIGNED**,

**primary key**(series\_id, elem\_index),

**foreign key**(series\_id) **references** Series(series\_id));

**create table** Region

(series\_id **int(10) UNSIGNED**,

elem\_index **int(10) UNSIGNED**,

x1 **float**(4,3),

y1 **float**(4,3),

x2 **float**(4,3),

y2 **float**(4,3),

**primary key**(series\_id, elem\_index, x1, y1, x2, y2),

**foreign key**(series\_id, elem\_index) Element(series\_id, elem\_index));

1. **Querys**

**1. Query to retrieve the name(s) of patient(s) with the highest number of readings of units of “LDL cholesterol in mg/dL” above 200 in the past 90 days**

**select** patient\_name

**from** Patient **natural join** Reading **natural join** Sensor **natural join** Wears

**where** value > 200 **and** units **like** 'LDL cholesterol in mg/dL' **and**

**TIMESTAMPDIFF(**day, read\_datetime, **CURRENT\_TIMESTAMP())** <= 90

**group by** patient\_name

**having count**(value) >= **all** (**select** **count**(value)

**from** Patient **natural join** Reading **natural join** Sensor **natural join** Wears

**where** value > 200 **and** units **like** 'LDL cholesterol in mg/dL' **and**

**TIMESTAMPDIFF(**day, read\_datetime, **CURRENT\_TIMESTAMP())** <= 90 **group by** patient\_name);

**2. Query to retrieve the name(s) of patient(s) who have been subject of studies with all devices of manufacturer “Medtronic” in the past calendar year**

**select** patient\_name

**from** Patient **as** p

**where not exists** (**select** serialnum

**from** Device **as** d

**where** manufacturer **like** 'Medtronic'

**and** serialnum **not in** (**select** serialnum

**from** Study **as** s, Request **as** r, Patient **as** p2

**where** s.request\_number = r.request\_number **and**

r.patient\_number = p2.patient\_number **and**

**YEAR**(s.study\_date) = **YEAR**(**CURRENT\_DATE()**) – 1 **and**

p.patient\_name = p2.patient\_name));

1. **Triggers**

In this version of *mysql*, it’s necessary to create two triggers: one for inserting data into Study table and another one for update it.

**1. Trigger to ensure that a doctor who prescribes an exam may not perform that same exam**

**delimiter $$**

**create trigger** prevent\_insert **before** **insert on** Study

**for each row**

**begin**

**if exists**(**select \***

**from** Request

**where** request\_number = new.request\_number **and** doctor\_id = new.doctor\_id) **then**

**call** doctor\_who\_prescribes\_an\_exame\_cannot\_perform\_the\_same\_exam();

**end if;**

**end$$**

**delimiter ;**

**delimiter $$**

**create trigger** prevent\_update **before update on** Study

**for each row**

**begin**

**if exists**(**select \***

**from** Request

**where** request\_number = new.request\_number and doctor\_id = new.doctor\_id) **then**

**call** doctor\_who\_prescribes\_an\_exame\_cannot\_perform\_the\_same\_exam();

**end if;**

**end$$**

**delimiter ;**

**2. Trigger to prevent someone from trying to associate a device to a patient in overlapping periods. Additionally, when this event occurs, a text message “Overlapping periods” will be thrown**

**delimiter $$**

**create trigger** prevent\_device\_association\_insert **before insert on** Wears

**for each row**

**begin**

**if exists**(**select \***

**from** Wears

**where** serialnum = **new.serialnum** **and** manufacturer = **new.manufacturer** **and** patient\_number <> **new.patient\_number** **and**

(((**TIMESTAMPDIFF**(second, start\_date, **new.end\_date**) >= 0) **and** (**TIMESTAMPDIFF**(second, **new.end\_date**, end\_date) >= 0)) **or**

((**TIMESTAMPDIFF**(second, start\_date, **new.start\_date**) >= 0) **and** (**TIMESTAMPDIFF**(second, **new.start\_date**, end\_date) >= 0)) **or**

((**TIMESTAMPDIFF**(second, **new.start\_date**, start\_date) >= 0) **and** (**TIMESTAMPDIFF**(second, end\_date, **new.end\_date**) >= 0)))) **then**

**signal sqlstate '45000' set message\_text** = 'Overlapping Periods';

**end if;**

**end$$**

**delimiter ;**

**delimiter $$**

**create trigger** prevent\_device\_association\_insert **before update on** Wears

**for each row**

**begin**

**if exists**(**select \***

**from** Wears

**where** serialnum = **new.serialnum** **and** manufacturer = **new.manufacturer** **and** patient\_number <> **new.patient\_number** **and**

(((**TIMESTAMPDIFF**(second, start\_date, **new.end\_date**) >= 0) **and** (**TIMESTAMPDIFF**(second, **new.end\_date**, end\_date) >= 0)) **or**

((**TIMESTAMPDIFF**(second, start\_date, **new.start\_date**) >= 0) **and** (**TIMESTAMPDIFF**(second, **new.start\_date**, end\_date) >= 0)) **or**

((**TIMESTAMPDIFF**(second, **new.start\_date**, start\_date) >= 0) **and** (**TIMESTAMPDIFF**(second, end\_date, **new.end\_date**) >= 0)))) **then**

**signal sqlstate '45000' set message\_text** = 'Overlapping Periods';

**end if;**

**end$$**

**delimiter ;**

These triggers prevent someone from inserting or updating a row in table Wears, if that insert or update include associating the same device to different patients in overlapping periods. However, if the same patient needs to extend or change the period of wearing a certain device, it’s possible to do it, if there isn’t another patient that is wearing that same device in an overlapping period.

1. **Function**

**delimiter $$**

**create function** region\_overlaps\_element(series\_id\_A int(10), elem\_index\_A int(10), x1\_B float(4,3), y1\_B float(4,3), x2\_B float(4,3), y2\_B float(4,3))

**returns int**

**begin**

**declare** overlaps **int**;

**select count**(r.elem\_index) **into** overlaps

**from** region **as** r

**where** r.series\_id = series\_id\_A **and** r.elem\_index = elem\_index\_A **and**

((r.x1 < x2\_B) and (r.x2 > x1\_B) and (r.y1 < y2\_B) and (r.y2 > y1\_B));

**if** overlaps > 0 **then**

**set** overlaps = 1;

**end if;**

**return** overlaps;

**end$$**

**delimiter ;**

This function *region\_overlaps\_element()* checks if a given Region B (x1\_B, y1\_B, x2\_B, y2\_B) overlaps with any region of Element A (series\_id\_A, elem\_index\_A). If overlaps return 1 (means TRUE). Otherwise returns 0 (means FALSE).

**NOTE:** it’s assumed that: x1 < x2 and y1< y2.

1. **Populate tables**

**insert into** Patient **values** ('P-1', 'John Smith', '1990-07-01', 'London');

**insert into** Patient **values** ('P-2', 'Roger Smith', '1987-05-05', 'Liverpool');

**insert into** Patient **values** ('P-3', 'James Bond', '1975-08-30', 'Bristol');

**insert into** Patient **values** ('P-4', 'Kelly Fernandez', '1985-10-06', 'London');

**insert into** Patient **values** ('P-5', 'Liz Wang', '1987-12-25', 'Birmingham');

**insert into** Patient **values** ('P-6', 'Richard Gun', '1965-11-15', 'Manchester');

**insert into** Patient **values** ('P-7', 'Gisele Joly', '1950-02-07', 'Manchester');

**insert into** Patient **values** ('P-8', 'Isaac Newton', '1966-04-09', 'Sheffield');

**insert into** Patient **values** ('P-9', 'Lilian Holmes', '1955-06-20', 'Liverpool');

**insert into** Patient **values** ('P-10', 'Wellington Ramirez', '1959-09-14', 'London');

**insert into** Doctor **values** ('P-1', 'D-101');

**insert into** Doctor **values** ('P-2', 'D-102');

**insert into** Doctor **values** ('P-3', 'D-103');

**insert into** Doctor **values** ('P-4', 'D-104');

**insert into** Doctor **values** ('P-5', 'D-105');

**insert into** Doctor **values** ('P-6', 'D-106');

**insert into** Doctor **values** ('P-7', 'D-107');

**insert into** Doctor **values** ('P-8', 'D-108');

**insert into** Doctor **values** ('P-9', 'D-109');

**insert into** Doctor **values** ('P-10', 'D-110');

**insert into** Device **values** ('S1', 'Siemens', 's6373');

**insert into** Device **values** ('B1', 'Bosch', 'b7566');

**insert into** Device **values** ('A1', 'Airsense', 'a9800');

**insert into** Device **values** ('A2', 'Airsense', 'a7658');

**insert into** Device **values** ('A3', 'Airsense', 'a3333');

**insert into** Device **values** ('A4', 'Airsense', 'a3333');

**insert into** Device **values** ('A5', 'Airsense', 'a9800');

**insert into** Device **values** ('S2', 'Siemens', 's3421');

**insert into** Device **values** ('B2', 'Bosch', 'b8765');

**insert into** Device **values** ('T1', 'Thermotec', 't2990');

**insert into** Device **values** ('T2', 'Thermotec', 't2990');

**insert into** Device **values** ('H1', 'Honeywell', 'h6776');

**insert into** Device **values** ('H2', 'Honeywell', 'h4444');

**insert into** Device **values** ('E1', 'Envitec', 'e5876');

**insert into** Device **values** ('E2', 'Envitec', 'e5876');

**insert into** Device **values** ('M1', 'Medtronic', 'm7891');

**insert into** Device **values** ('M2', 'Medtronic', 'm4536');

**insert into** Device **values** ('M3', 'Medtronic', 'm6543');

**insert into** Device **values** ('M4', 'Medtronic', 'm9023');

**insert into** Device **values** ('M5', 'Medtronic', 'm7123');

**insert into** Device **values** ('S3', 'Siemens', 's4040');

**insert into** Device **values** ('S4', 'Siemens', 's3131');

**insert into** Device **values** ('S5', 'Siemens', 's1111');

**insert into** Device **values** ('B3', 'Bosch', 'b4589');

**insert into** Device **values** ('B4', 'Bosch', 'b3232');

**insert into** Device **values** ('B5', 'Bosch', 'b4455');

**insert into** Device **values** ('I1', 'Iberdata', 'i3030');

**insert into** Device **values** ('I2', 'Iberdata', 'i9009');

**insert into** Device **values** ('I3', 'Iberdata', 'i7050');

**insert into** Device **values** ('I4', 'Iberdata', 'i3553');

**insert into** Device **values** ('I5', 'Iberdata', 'i7005');

**insert into** Device **values** ('I6', 'Iberdata', 'i6531');

**insert into** Sensor **values** ('S1', 'Siemens', 'LDL cholesterol in mg/dL');

**insert into** Sensor **values** ('B1', 'Bosch', 'Creatinine in mg/L');

**insert into** Sensor **values** ('A1', 'Airsense', 'HDL cholesterol in mg/dL');

**insert into** Sensor **values** ('A2', 'Airsense', 'Hemoglobin in g/dL');

**insert into** Sensor **values** ('A3', 'Airsense', 'Creatinine in mg/L');

**insert into** Sensor **values** ('A4', 'Airsense', 'Creatinine in mg/L');

**insert into** Sensor **values** ('A5', 'Airsense', 'Hemoglobin in g/dL');

**insert into** Sensor **values** ('S2', 'Siemens', 'HDL cholesterol in mg/dL');

**insert into** Sensor **values** ('B2', 'Bosch', 'LDL cholesterol in mg/dL');

**insert into** Sensor **values** ('T1', 'Thermotec', 'Temperature in ºC');

**insert into** Sensor **values** ('T2', 'Thermotec', 'Temperature in ºC');

**insert into** Sensor **values** ('H1', 'Honeywell', 'Glucose level in mmol/L');

**insert into** Sensor **values** ('H2', 'Honeywell', 'Glucose level in mmol/L');

**insert into** Sensor **values** ('E1', 'Envitec', 'Hemoglobin in g/dL');

**insert into** Sensor **values** ('E2', 'Envitec', 'Creatinine in mg/L');

**insert into** Reading **values** ('S1', 'Siemens', '2017-10-30 18:20:00', 217);

**insert into** Reading **values** ('S1', 'Siemens', '2017-10-30 18:21:00', 225);

**insert into** Reading **values** ('S1', 'Siemens', '2017-10-15 13:12:11', 220);

**insert into** Reading **values** ('S1', 'Siemens', '2017-10-17 20:08:21', 201);

**insert into** Reading **values** ('B1', 'Bosch', '2017-10-15 10:17:55', 10.1);

**insert into** Reading **values** ('A1', 'Airsense', '2017-07-31 15:25:45', 77);

**insert into** Reading **values** ('A1', 'Airsense', '2017-08-7 08:54:07', 100);

**insert into** Reading **values** ('A2', 'Airsense', '2017-10-31 09:57:35', 12.8);

**insert into** Reading **values** ('A2', 'Airsense', '2017-03-17 11:47:59', 15.7);

**insert into** Reading **values** ('A3', 'Airsense', '2016-12-25 20:20:20', 8.2);

**insert into** Reading **values** ('A4', 'Airsense', '2017-01-20 23:17:05', 11.8);

**insert into** Reading **values** ('A5', 'Airsense', '2017-03-29 21:40:47', 17.2);

**insert into** Reading **values** ('S2', 'Siemens', '2017-01-29 19:20:27', 117);

**insert into** Reading **values** ('B2', 'Bosch', '2017-10-14 10:39:06', 224);

**insert into** Reading **values** ('T1', 'Thermotec', '2017-10-28 07:44:21', 35);

**insert into** Reading **values** ('T2', 'Thermotec', '2016-04-06 09:45:17', 36.5);

**insert into** Reading **values** ('T2', 'Thermotec', '2016-07-16 11:12:12', 34.7);

**insert into** Reading **values** ('H1', 'Honeywell', '2017-10-31 12:55:59', 5.9);

**insert into** Reading **values** ('H2', 'Honeywell', '2016-04-17 14:32:58', 7.5);

**insert into** Reading **values** ('E1', 'Envitec', '2016-01-30 16:27:44', 17.9);

**insert into** Reading **values** ('E2', 'Envitec', '2017-05-29 19:42:28', 12.2);

**insert into** Period **values** ('2017-04-01 10:00:01', '2017-10-31 17:18:19');

**insert into** Period **values** ('2017-01-17 08:11:17', '2017-10-25 19:00:91');

**insert into** Period **values** ('2016-01-02 10:08:00', '2030-12-31 00:00:00');

**insert into** Period **values** ('2017-03-04 12:34:55', '2030-12-31 00:00:00');

**insert into** Period **values** ('2015-05-08 22:30:05', '2030-12-31 00:00:00');

**insert into** Period **values** ('2016-02-26 13:08:45', '2030-12-31 00:00:00');

**insert into** Period **values** ('2016-07-31 15:03:41', '2017-09-17 13:00:07');

**insert** **into** Period **values** ('2016-08-26 21:00:23', '2017-02-23 17:55:42');

**insert into** Period **values** ('2017-04-06 12:07:44', '2030-12-31 00:00:00');

**insert into** Period **values** ('2016-01-12 00:00:00', '2017-11-02 07:15:18');

**insert into** Period **values** ('2017-05-10 11:12:15', '2030-12-31 00:00:00');

**insert into** Period **values** ('2016-04-2 08:11:17', '2016-12-15 00:00:00');

**insert into** Period **values** ('2016-03-20 20:17:25', '2017-01-01 10:00:10');

**insert into** Period **values** ('2016-01-07 12:00:15', '2016-04-28 17:17:17');

**insert into** Period **values** ('2016-01-02 09:30:27', '2016-01-07 18:20:24');

**insert into** Period **values** ('2017-02-01 10:10:10', '2020-02-01 00:00:00');

**insert into** Period **values** ('2017-11-01 00:00:00', '2017-11-05 00:00:00');

**insert into** Wears **values** ('2017-04-01 10:00:01', '2017-10-31 17:18:19', 'P-1', 'S1', 'Siemens');

**insert into** Wears **values** ('2017-01-17 08:11:17', '2017-10-25 19:00:21', 'P-2', 'B1', 'Bosch');

**insert into** Wears **values** ('2016-01-02 10:08:00', '2030-12-31 00:00:00', 'P-3', 'A1', 'AirSense');

**insert into** Wears **values** ('2017-03-04 12:34:55', '2030-12-31 00:00:00', 'P-4', 'A2', 'AirSense');

**insert into** Wears **values** ('2015-05-08 22:30:05', '2030-12-31 00:00:00', 'P-5', 'A3', 'AirSense');

**insert into** Wears **values** ('2016-02-26 13:08:45', '2030-12-31 00:00:00', 'P-6', 'A4', 'AirSense');

**insert into** Wears **values** ('2016-07-31 15:03:41', '2017-09-17 13:00:07', 'P-7', 'A5', 'AirSense');

**insert into** Wears **values** ('2016-08-26 21:00:23', '2017-02-23 17:55:42', 'P-8', 'S2', 'Siemens');

**insert into** Wears **values** ('2017-04-06 12:07:44', '2030-12-31 00:00:00', 'P-9', 'B2', 'Bosch');

**insert into** Wears **values** ('2016-01-12 00:00:00', '2017-11-02 07:15:18', 'P-10', 'T1', 'Thermotec');

**insert into** Wears **values** ('2017-05-10 11:12:15', '2030-12-31 00:00:00', 'P-8', 'H1', 'Honeywell');

**insert into** Wears **values** ('2016-04-02 08:11:10', '2016-12-15 00:01:10', 'P-2', 'T2', 'Thermotec');

**insert into** Wears **values** ('2016-03-20 20:17:25', '2017-01-01 10:00:10', 'P-1', 'H2', 'Honeywell');

**insert into** Wears **values** ('2016-01-07 12:00:15', '2016-04-28 17:17:17', 'P-7', 'E1', 'Envitec');

**insert into** Wears **values** ('2016-01-02 09:30:27', '2016-01-07 18:20:24', 'P-10', 'E2', 'Envitec');

**insert into** Request **values** (1, 'P-1', 'D-101', '2016-02-07');

**insert into** Request **values** (2, 'P-2', 'D-102', '2017-07-17');

**insert into** Request **values** (3, 'P-3', 'D-103', '2016-05-15');

**insert into** Request **values** (4, 'P-4', 'D-104', '2017-08-31');

**insert into** Request **va**l**ues** (5, 'P-5', 'D-105', '2016-10-16');

**insert into** Request **values** (6, 'P-6', 'D-106', '2016-09-21');

**insert into** Request **values** (7, 'P-7', 'D-107', '2017-04-19');

**insert** **into** Request **values** (8, 'P-8', 'D-108', '2017-01-21');

**insert into** Request **values** (9, 'P-9', 'D-109', '2016-12-16');

**insert into** Request **values** (10, 'P-10' 'D-110', '2017-06-25');

**insert into** Request **values** (11, 'P-5', 'D-105', '2017-05-09');

**insert into** Request **values** (12, 'P-7', 'D-107', '2017-10-24');

**insert into** Request **values** (13, 'P-8', 'D-108', '2016-07-05');

**insert into** Request **values** (14, 'P-2', 'D-102', '2016-04-02');

**insert into** Request **values** (15, 'P-1', 'D-101', '2016-10-09');

**insert into** Request **values** (16, 'P-3', 'D-103', '2017-09-06');

**insert into** Request **values** (17, 'P-4', 'D-104', '2017-03-11');

**insert into** Request **values** (18, 'P-3', 'D-103', '2016-02-10');

**insert** **into** Request **values** (19, 'P-3', 'D-103', '2016-04-03');

**insert into** Request **values** (20, 'P-3', 'D-103', '2016-07-20');

**insert into** Request **values** (21, 'P-3', 'D-103', '2016-09-07');

**insert into** Study **values** (1, 'X-ray both feet', '2016-03-05', 'D-102', 'Medtronic', 'M1');

**insert into** Study **values** (2, 'Ecography both feet', '2017-08-30', 'D-101', 'Medtronic', 'M2');

**insert into** Study **values** (3, 'Endoscopy esophagus', '2016-06-02', 'D-105', 'Medtronic', 'M3');

**insert into** Study **values** (4, 'Endoscopy stomach', '2017-10-07', 'D-103', 'Medtronic', 'M4');

**insert into** Study **values** (5, 'Echocardiography', '2016-10-31', 'D-104', 'Medtronic', 'M5');

**insert into** Study **values** (6, 'Mammography', '2016-03-05', 'D-107', 'Iberdata', 'I6');

**insert into** Study **values** (7, 'Colonoscopy', '2017-05-12', 'D-110', 'Siemens', 'S3');

**insert into** Study **values** (8, 'Magnetic Resonance both shoulders', '2017-02-25', 'D-101', 'Siemens', 'S4');

**insert into** Study **values** (9, 'Magnetic Resonance both knees', '2017-01-08', 'D-108', 'Siemens', 'S5');

**insert into** Study **values** (10, 'Electrocardiogram', '2017-07-27', 'D-109', 'Bosch', 'B3');

**insert into** Study **values** (11, 'Electrocardiogram', '2017-10-08', 'D-106', 'Bosch', 'B4');

**insert into** Study **values** (12, 'Prostate Specific Antigen (PSA test)', '2017-10-31', 'D-102', 'Bosch', 'B5');

**insert into** Study **values** (13, 'Mammography', '2017-07-27', 'D-107', 'Iberdata', 'I1');

**insert into** Study **values** (14, 'Colonoscopy', '2017-05-09', 'D-105', 'Iberdata', 'I2');

**insert into** Study **values** (15, 'Echocardiography', '2017-10-29', 'D-108', 'Iberdata', 'I3');

**insert into** Study **values** (16, 'X-ray chest', '2017-10-01', 'D-102', 'Iberdata', 'I4');

**insert into** Study **values** (17, 'X-ray both elbows', '2017-05-27', 'D-101', 'Iberdata', 'I5');

**insert into** Study **values** (18, 'X-ray right foot', '2016-03-25', 'D-104', 'Medtronic', 'M1');

**insert into** Study **values** (19, 'Ecography left foot', '2016-08-31', 'D-109', 'Medtronic', 'M2');

**insert into** Study **values** (20, 'Endoscopy stomach', '2016-10-10', 'D-110', 'Medtronic', 'M4');

**insert into** Study **values** (21, 'Echocardiography', '2016-10-17', 'D-105', 'Medtronic', 'M5');

**insert into** Series **values** (1, 'X-ray right foot', 'http://www.healthcarecentre/11/', 1, 'X-ray both feet');

**insert into** Series **values** (2, 'X-ray left foot', 'http://www.healthcarecentre/21/', 1, 'X-ray both feet');

**insert into** Series **values** (3, 'Ecography right foot', 'http://www.healthcarecentre/32/', 2, 'Ecography both feet');

**insert into** Series **values** (4, 'Ecography left foot', 'http://www.healthcarecentre/42/', 2, 'Ecography both feet');

**insert into** Series **values** (5, 'Endoscopy esophagus', 'http://www.healthcarecentre/53/', 3, 'Endoscopy esophagus');

**insert into** Series **values** (6, 'Endoscopy stomach', 'http://www.healthcarecentre/64/', 4, 'Endoscopy stomach');

**insert into** Series **values** (7, 'Echocardiography', 'http://www.healthcarecentre/75/', 5, 'Echocardiography');

**insert into** Series **values** (8, 'Mammography', 'http://www.healthcarecentre/86/', 6, 'Mammography');

**insert into** Series **values** (9, 'Colonoscopy', 'http://www.healthcarecentre/97/', 7, 'Colonoscopy');

**insert into** Series **values** (10, 'Magnetic Resonance right shoulder', 'http://www.healthcarecentre/108/', 8, 'Magnetic Resonance both shoulders');

**insert into** Series **values** (11, 'Magnetic Resonance left shoulder', 'http://www.healthcarecentre/118/', 8, 'Magnetic Resonance both shoulders');

**insert into** Series **values** (12, 'Magnetic Resonance right knee', 'http://www.healthcarecentre/129/', 9, 'Magnetic Resonance both shoulders');

**insert into** Series **values** (13, 'Magnetic Resonance left knee', 'http://www.healthcarecentre/139/', 9, 'Magnetic Resonance both shoulders');

**insert into** Series **values** (14, 'Electrocardiogram', 'http://www.healthcarecentre/1410/', 10, 'Electrocardiogram');

**insert into** Series **values** (15, 'Electrocardiogram', 'http://www.healthcarecentre/1511/', 11, 'Electrocardiogram');

**insert into** Series **values** (16, 'Prostate Specific Antigen (PSA test)', 'http://www.healthcarecentre/1612/', 12, 'Prostate Specific Antigen (PSA test)');

**insert into** Series **values** (17, 'Mammography', 'http://www.healthcarecentre/1713/', 13, 'Mammography');

**insert into** Series **values** (18, 'Colonoscopy', 'http://www.healthcarecentre/1814/', 14, 'Colonoscopy');

**insert into** Series **values** (19, 'Echocardiography', 'http://www.healthcarecentre/1915/', 15, 'Echocardiography');

**insert into** Series **values** (20, 'X-ray chest', 'http://www.healthcarecentre/2016/', 16, 'X-ray chest');

**insert into** Series **values** (21, 'X-ray right elbow', 'http://www.healthcarecentre/2117/', 17, 'X-ray both elbows');

**insert into** Series **values** (22, 'X-ray left elbow', 'http://www.healthcarecentre/2217/', 17, 'X-ray both elbows');

**insert into** Series **values** (23, 'X-ray right foot', 'http://www.healthcarecentre/2318/', 18, 'X-ray right foot');

**insert into** Series **values** (24, 'Ecography left foot', 'http://www.healthcarecentre/2419/', 19, 'Ecography left foot');

**insert into** Series **values** (25, 'Endoscopy stomach', 'http://www.healthcarecentre/2520/', 20, 'Endoscopy stomach');

**insert into** Series **values** (26, 'Echocardiography', 'http://www.healthcarecentre/2621/', 21, 'Echocardiography');

**insert into** Element **values** (1, 1);

**insert into** Element **values** (1, 2);

**insert into** Element **values** (1, 3);

**insert into** Element **values** (2, 1);

**insert into** Element **values** (2, 2);

**insert into** Element **values** (3, 1);

**insert into** Element **values** (3, 2);

**insert into** Element **values** (3, 3);

**insert into** Element **values** (3, 4);

**insert into** Element **values** (4, 1);

**insert into** Element **values** (4, 2);

**insert into** Element **values** (5, 1);

**insert into** Element **values** (5, 2);

**insert into** Element **values** (6, 1);

**insert into** Element **values** (6, 2);

**insert into** Element **values** (7, 1);

**insert into** Element **values** (7, 2);

**insert into** Element **values** (8, 1);

**insert into** Element **values** (8, 2);

**insert into** Element **values** (8, 3);

**insert into** Element **values** (8, 4);

**insert into** Element **values** (9, 1);

**insert into** Element **values** (9, 2);

**insert into** Element **values** (10, 1);

**insert into** Element **values** (10, 2);

**insert into** Element **values** (11, 1);

**insert into** Element **values** (11, 2);

**insert into** Element **values** (12, 1);

**insert into** Element **values** (12, 2);

**insert into** Element **values** (13, 1);

**insert into** Element **values** (13, 2);

**insert into** Element **values** (14, 1);

**insert into** Element **values** (14, 2);

**insert into** Element **values** (15, 1);

**insert into** Element **values** (15, 2);

**insert into** Element **values** (16, 1);

**insert into** Element **values** (16, 2);

**insert into** Element **values** (17, 1);

**insert into** Element **values** (17, 2);

**insert into** Element **values** (18, 1);

**insert into** Element **values** (18, 2);

**insert into** Element **values** (19, 1);

**insert into** Element **values** (19, 2);

**insert into** Element **values** (20, 1);

**insert into** Element **values** (20, 2);

**insert into** Element **values** (21, 1);

**insert into** Element **values** (21, 2);

**insert** **into** Element **values** (22, 1);

**insert into** Element **values** (22, 2);

**insert into** Element **values** (22, 3);

i**nsert into** Element **values** (22, 4);

**insert into** Region **values** (1, 1, 0.107, 0.638, 0.180, 0.762);

**insert into** Region **values** (1, 2, 0.230, 0.567, 0.443, 0.899);

**insert into** Region **values** (1, 3, 0.432, 0.565, 0.118, 0.779);

**insert into** Region **values** (2, 1, 0.508, 0.234, 0.734, 0.923);

**insert into** Region **values** (2, 1, 0.100, 0.100, 0.230, 0.230);

**insert into** Region **values** (2, 2, 0.214, 0.657, 0.978, 0.999);

**insert into** Region **values** (3, 1, 0.115, 0.376, 0.647, 0.762);

**insert into** Region **values** (3, 2, 0.534, 0.980, 0.234, 0.762);

**insert into** Region **values** (3, 3, 0.675, 0.192, 0.567, 0.762);

**insert into** Region **values** (3, 4, 0.453, 0.876, 0.290, 0.834);

**insert into** Region **values** (4, 1, 0.489, 0.789, 0.117, 0.878);

**insert into** Region **values** (4, 2, 0.222, 0.333, 0.444, 0.555);

**insert into** Region **values** (5, 1, 0.654, 0.218, 0.905, 0.675);

**insert into** Region **values** (5, 2, 0.232, 0.798, 0.190, 0.458);

**insert into** Region **values** (6, 1, 0.616, 0.717, 0.818, 0.919);

**insert into** Region **values** (6, 2, 0.111, 0.999, 0.222, 0.777);

**insert into** Region **values** (7, 1, 0.668, 0.669, 0.888, 0.889);

**insert into** Region **values** (7, 2, 0.558, 0.475, 0.222, 0.332);

**insert into** Region **values** (8, 1, 0.142, 0.173, 0.194, 0.289);

**insert into** Region **values** (8, 2, 0.765, 0.975, 0.333, 0.777);

**insert into** Region **values** (8, 3, 0.211, 0.991, 0.224, 0.664);

**insert into** Region **values** (8, 4, 0.168, 0.845, 0.333, 0.456);

**insert into** Region **values** (9, 1, 0.121, 0.343, 0.565, 0.787);

**insert into** Region **values** (9, 2, 0.099, 0.677, 0.345, 0.899);

**insert into** Region **values** (10, 1, 0.321, 0.654, 0.765, 0.987);

**insert into** Region **values** (10, 2, 0.545, 0.878, 0.688, 0.727);

**insert into** Region **values** (11, 1, 0.646, 0.789, 0.889, 0.989);

**insert into** Region **values** (11, 2, 0.109, 0.234, 0.565, 0.898);

**insert into** Region **values** (12, 1, 0.212, 0.245, 0.656, 0.787);

**insert into** Region **values** (12, 2, 0.893, 0.909, 0.345, 0.897);

**insert into** Region **values** (13, 1, 0.666, 0.999, 0.222, 0.666);

**insert into** Region **values** (13, 2, 0.878, 0.989, 0.356, 0.676);

**insert into** Region **values** (14, 1, 0.111, 0.225, 0.348, 0.987);

**insert into** Region **values** (14, 2, 0.590, 0.334, 0.212, 0.455);

**insert into** Region **values** (15, 1, 0.690, 0.990, 0.213, 0.676);

**insert into** Region **values** (15, 2, 0.276, 0.387, 0.432, 0.878);

**insert into** Region **values** (16, 1, 0.175, 0.345, 0.478, 0.889);

**insert into** Region **values** (16, 2, 0.289, 0.367, 0.878, 0.995);

**insert into** Region **values** (17, 1, 0.567, 0.890, 0.345, 0.789);

**insert into** Region **values** (17, 2, 0.465, 0.443, 0.556, 0.954);

**insert into** Region **values** (18, 1, 0.586, 0.669, 0.665, 0.753);

**insert into** Region **values** (18, 2, 0.123, 0.456, 0.789, 0.890);

**insert into** Region **values** (19, 1, 0.643, 0.717, 0.542, 0.999);

**insert into** Region **values** (19, 2, 0.545, 0.878, 0.688, 0.727);

**insert into** Region **values** (20, 1, 0.534, 0.796, 0.968, 0.998);

**insert into** Region **values** (20, 2, 0.321, 0.543, 0.765, 0.987);

**insert into** Region **values** (21, 1, 0.199, 0.299, 0.399, 0.599);

**insert into** Region **values** (21, 2, 0.209, 0.309, 0.409, 0.509);

**insert into** Region **values** (22, 1, 0.534, 0.756, 0.867, 0.957);

**insert into** Region **values** (22, 2, 0.476, 0.874, 0.565, 0.878);

**insert into** Region **values** (22, 3, 0.223, 0.345, 0.678, 0.967);

**insert into** Region **values** (22, 4, 0.234, 0.678, 0.456, 0.789);

1. **Expected Results**

* Figure 1 shows the result of the first query, which are the patients with the highest number of readings of ‘LDL cholesterol in mg/dL’ above 200 in the past 90 days:

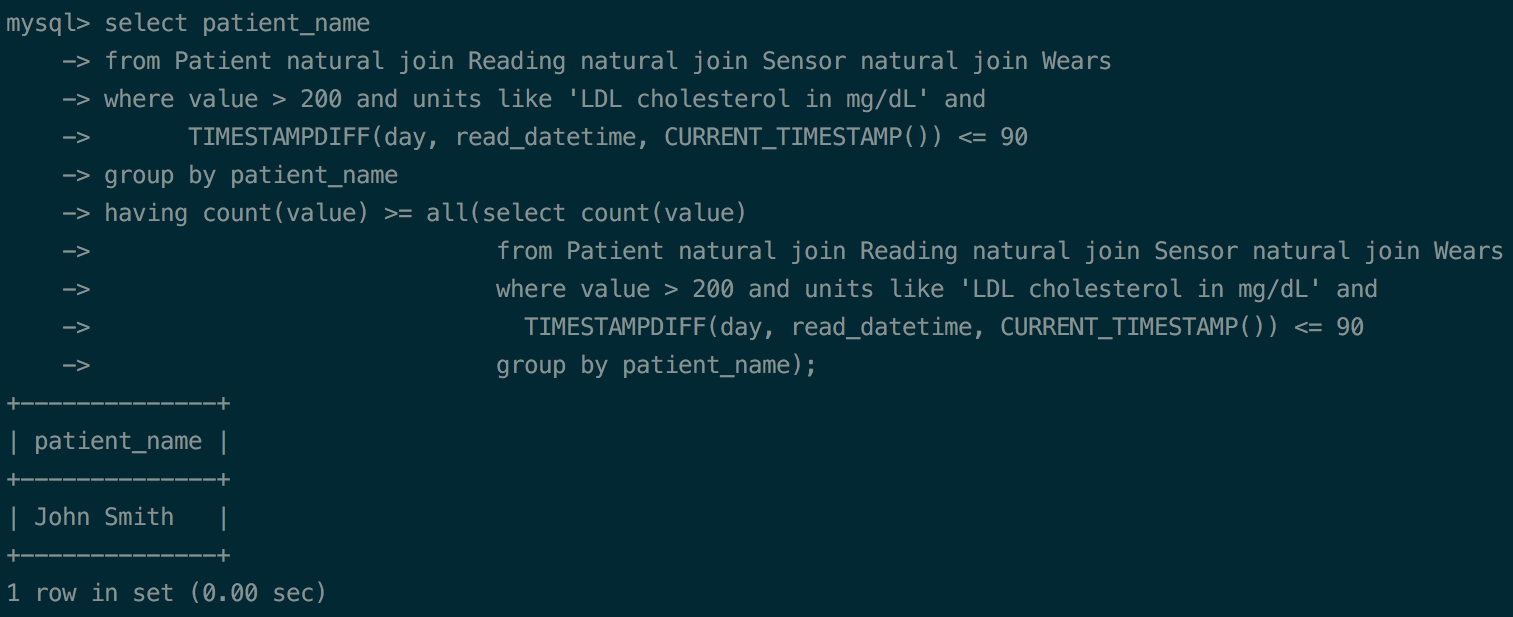


Figure 1 – Result of the first query

* Figure 2 shows the result of the second query, which are the patients who have been subject of studies with all devices of manufacturer ‘Medtronic’:

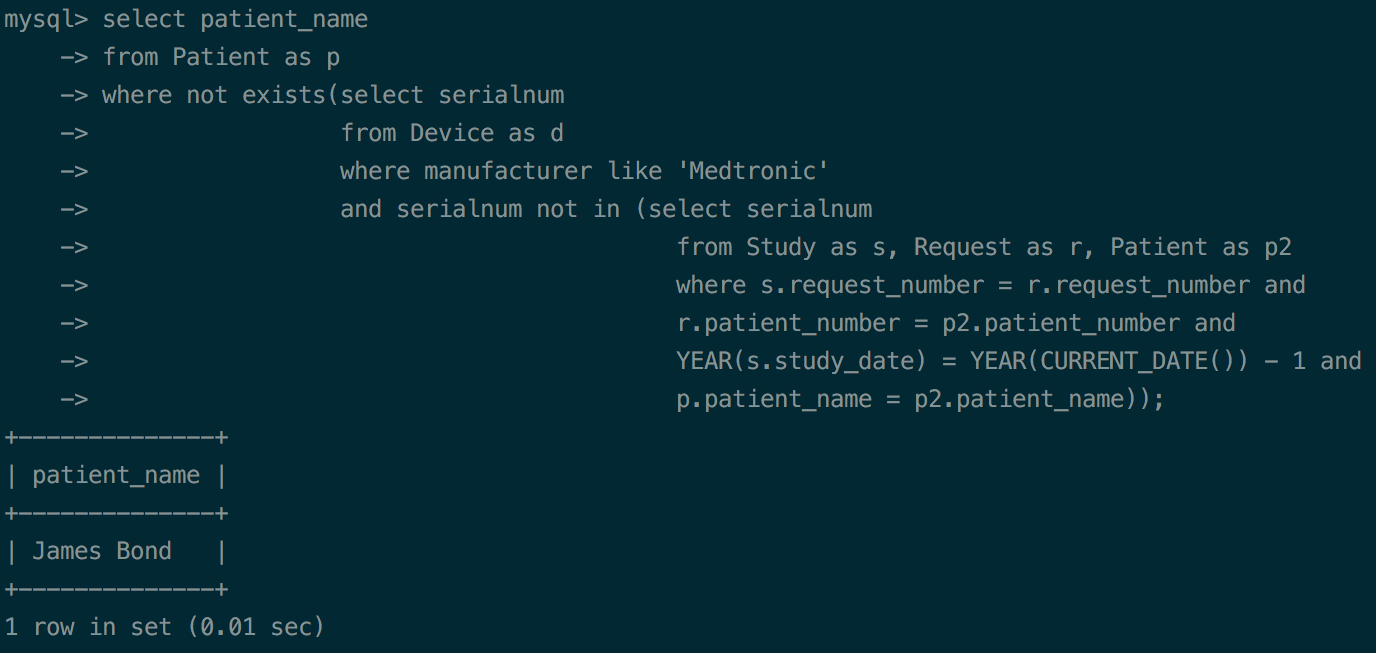


Figure 2 - Result of the second query

* Figures 3.1 and 3.2 show examples of the implementation of trigger 1, one for inserting a new record (prevent\_insert) and another one for updating an existing row (prevent\_update), in the table Study, respectively:

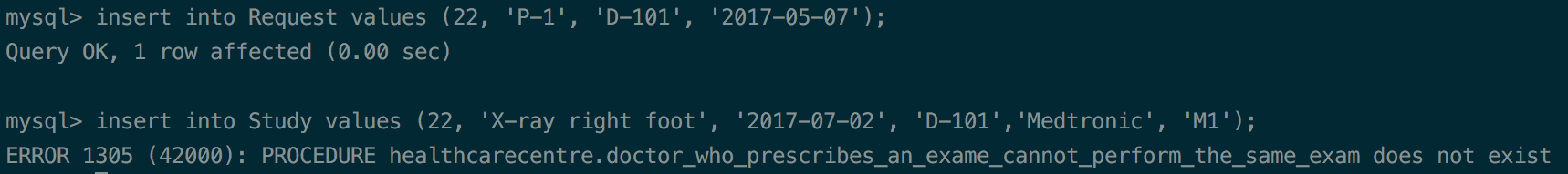
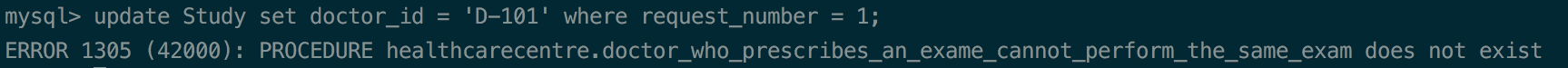


Figure 3.2 - Trigger 1 (prevent\_update) example for updating an existing row, trying to change the doctor of a study to the same doctor that made the request

Figure 4.1 - Trigger 1 (prevent\_insert) example for trying to insert a record in Study table that has the same doctor that requested the exam

* Figures 4.1, 4.2, 4.3 and 4.4 show examples of the implementation of trigger 2, two (4.1 and 4.4) for inserting a new record (prevent\_device\_association\_insert) and another two (4.2 and 4.3) for updating an existing row (prevent\_device\_association\_update) in the table Wears, respectively:

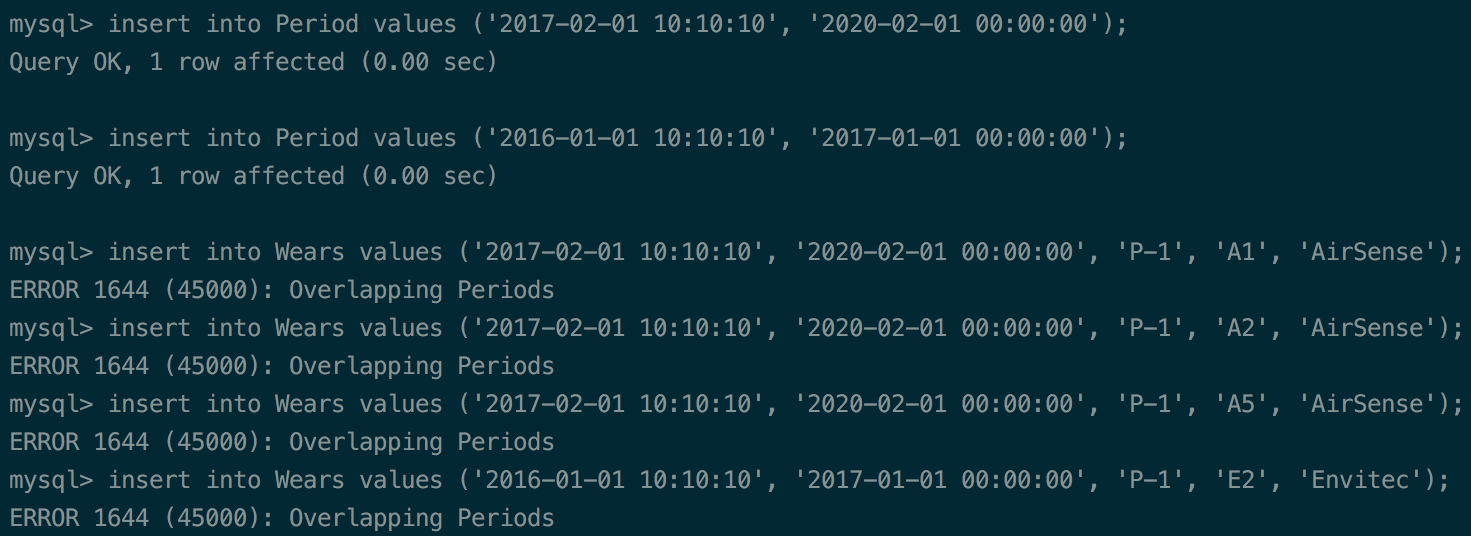


Figure 4.1 - Trigger 2 (prevent\_device\_association\_insert) example for trying to insert records that associates the same device, in overlapping periods, for two different patients, in Wears table

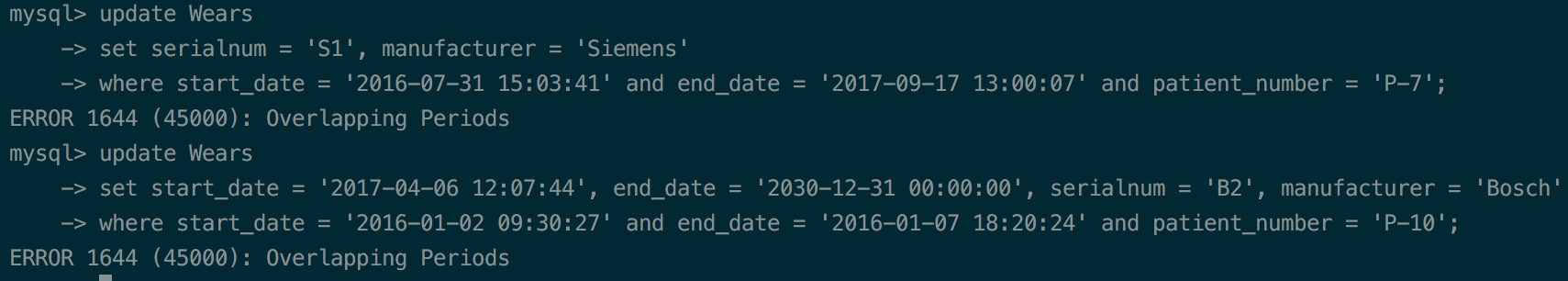
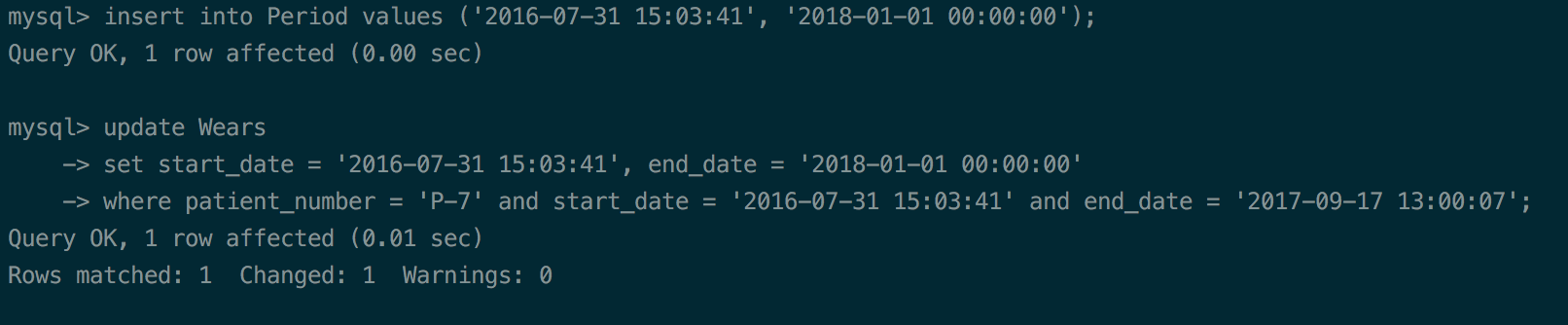


Figure 4.2 - Trigger 2 (prevent\_device\_association\_update) example for updating an existing row, trying to associate a device to different patients, in overlapping periods



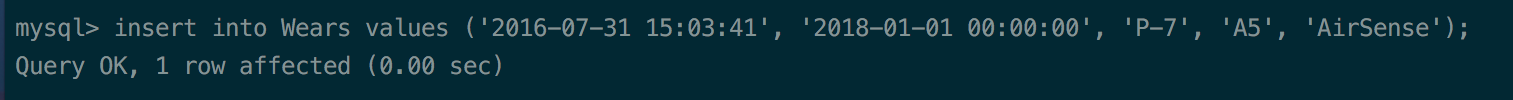


Figure 4.4 – Trigger 2 (prevent\_device\_association\_insert) example for trying to insert a new record in table Wears that is an extension of a period while a patient is wearing a device

Figure 4.3 – Trigger 2 (prevent\_device\_association\_update) example for trying to update a record in table Wears the is an extension of a period while a patient is wearing a device

* Figure 5.1, 5.2 and 5.3 show examples of the implementation of function *region\_overlaps\_element()*:

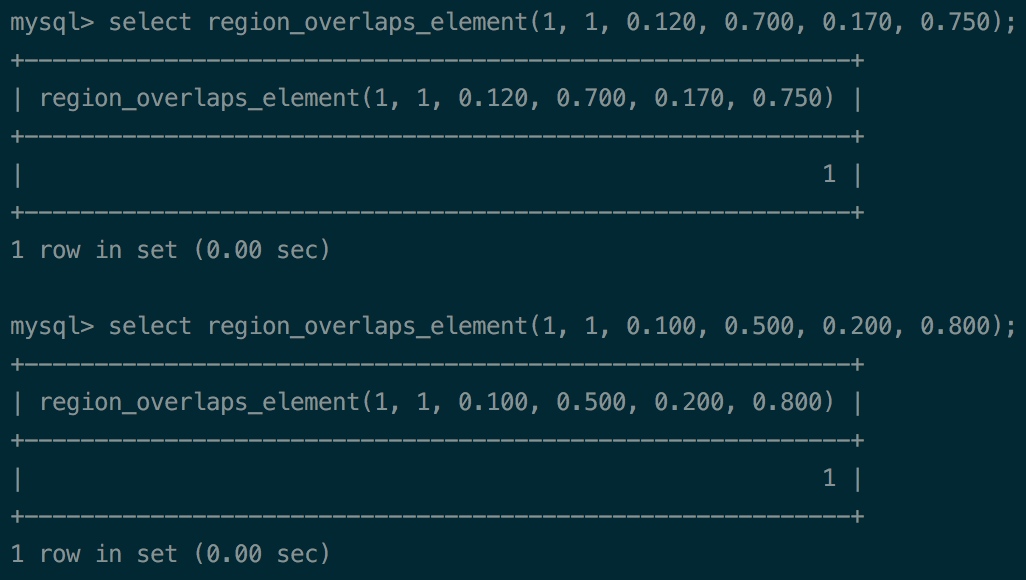


Figure 5.1 - Region B overlaps with region of element A – returns 1, that means TRUE

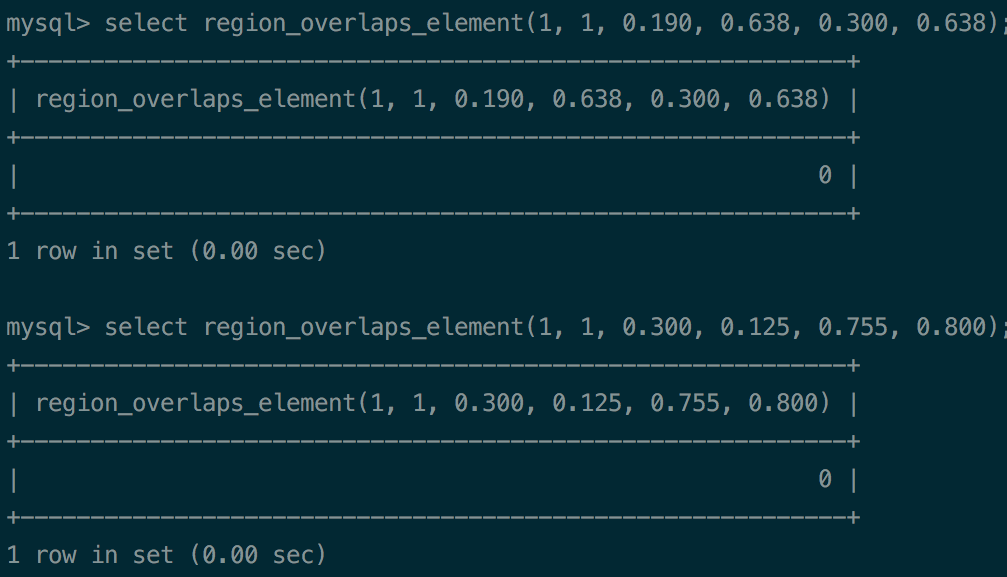


Figure 5.2 – Region B don’t overlap with region of element A – returns 0, that means FALSE

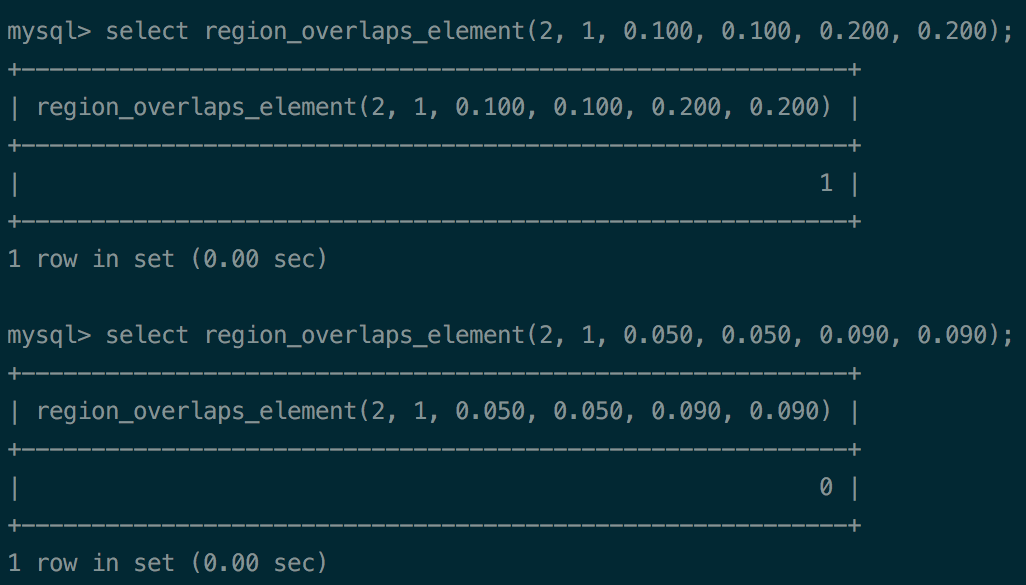


Figure 5.3 – In this case, element 1 from series\_id = 2, has two regions and in the first case the given region B overlaps with one of them and in the second case don’t overlap with any of them