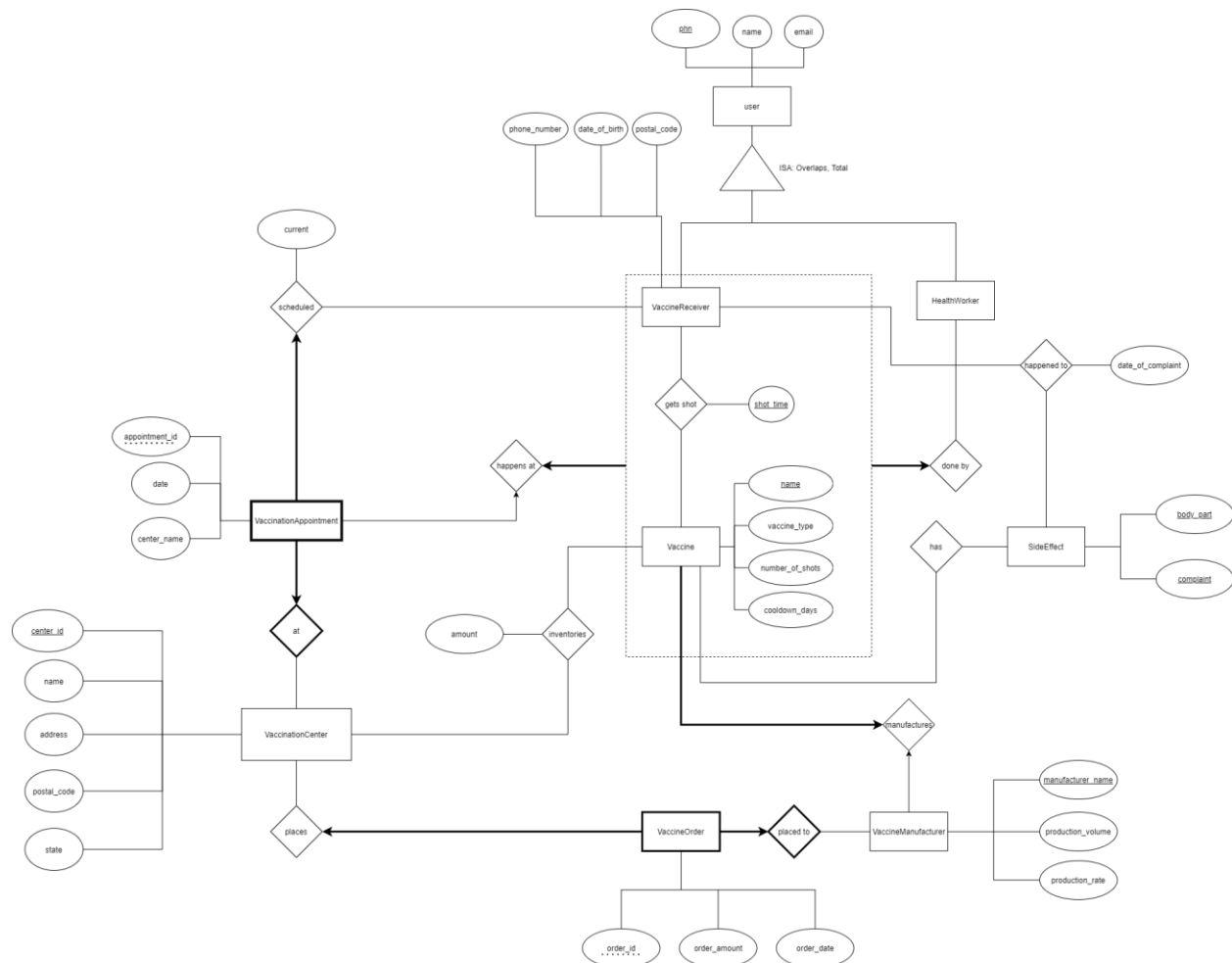1. Cover page has been uploaded to canvas with the submission

2. Following changes have been made in the ER diagram:-
   ● Removed Vaccine Inventory, replaced it with a relationship between Vaccination Center and Vaccine. Vaccine Inventory entity must have belonged to a center and a vaccine, thus it was a trivial entity.
   ● We have bolded the vaccine order as it is a weak entity.
   ● We have changed the relationship between Vaccine and Side effect from [many to one] to [many to many] because one vaccine can have many side effects and one particular side effect can be associated with more than one type of vaccine.
   ● We have removed the Country attribute from Vaccination center and user entities because we want to make this database management system for Canada only.
   ● VaccineReceiver has distinct attributes from Health Worker as we don't want to store such information about the health worker.
   ● Added CenterName attribute to VaccinationAppointment entity to make it in 2NF instead of BCNF (To satisfy 4a)
   ● Updated all names to match DDL statements.

3. <u>PRIMARY KEYS-UNDERLINED</u>
   FOREIGN KEYS-IN BOLD

VaccineManufacturer(
      <u>manufacturer_name</u> CHAR(32),
      production_volume INTEGER,
      production_rate INTEGER
)
##CANDIDATE KEYS:
      -(manufacturer_name)

VaccineOrder(
  <u>order_id</u> INTEGER,
  manufacturer_name CHAR(32),
  center_id INTEGER NOT NULL,
  order_amount INTEGER,
  order_date DATETIME,
)
##CANDIDATE KEYS:
      -(order_id, manufacturer_name)

VaccinationCenter(
  <u>center_id</u> INTEGER,
  name CHAR(32),
  address CHAR(32),
  postal_code CHAR(7),
  state CHAR(32),
);
##CANDIDATE KEYS:
      -(address, postal_code)
      -(center_id)

VaccinationAppointment(
  <u>appointment_id</u> INTEGER,
  center_id INTEGER,
  date DATETIME,
  center_name CHAR(128),
  current BOOLEAN,
  receiver_phn BIGINT NOT NULL
)
##CANDIDATE KEYS:
      -(appointment_id)

Vaccine(
  <u>name</u> CHAR(25),
  vaccine_type CHAR(32),
  number_of_shots INTEGER,
  cooldown_days INTEGER,
  manufacturer_name CHAR(32) UNIQUE
)
##CANDIDATE KEYS:
     -(name)
     -(manufacturer_name)

VaccineReceiver(
  <u>phn</u> BIGINT,
  name CHAR(32),
  email CHAR(40),
  phone_number BIGINT,
  date_of_birth DATE,
  postal_code CHAR(7)
)
##CANDIDATE KEYS:-
     -(phn)

HealthWorker(
  <u>phn</u> BIGINT,
  name CHAR(40),
  email CHAR(40)
)
##CANDIDATE KEYS:
     -(phn)

SideEffect(
  <u>body_part</u> CHAR(40),
  <u>complaint</u> CHAR(50),
)
##CANDIDATE KEYS:
     -(body_part, complaint)

SideEffectHappenedToVaccineReceiver(
  <u>receiver_phn</u> BIGINT,
  <u>body_part</u> CHAR(40),
  <u>complaint</u> CHAR(50),
  date_of_complaint DATE
)
##CANDIDATE KEYS: -(receiver_phn **,** body_part, complaint)

VaccineRecieverGetsShotVaccine(
   receiver_phn BIGINT NOT NULL,
   vaccine_name CHAR(50) NOT NULL,
   shot_time DATETIME,
   healthWorker_phn BIGINT NOT NULL,
   appointment_id INTEGER,
   center_id INTEGER
)
##CANDIDATE KEYS:-
      -(receiver_phn**,** vaccine_name, shot_time)
      -(appointment_id**,** center_id)

VaccineHasSideEffect(
   vaccine_name CHAR(25),
   body_part CHAR(40),
   complaint CHAR(50),
)
##CANDIDATE KEYS:-
      -(vaccine_name, body_part, complaint)

VaccinationCenterInventoriesVaccine(
   center_id INTEGER,
   vaccine_name CHAR(25),
   amount INTEGER,
)
##CANDIDATE KEYS:-
      -(center_id, vaccine_name)

4:

VaccineManufacturer:

(manufacturer_name) => (production_volume, production_rate)

VaccineOrder:

(order_id, manufacturer_name) => (center_id, order_amount, order_date)

VaccinationCenter:

(center_id) => (name, address, postal_code, state)

(postal_code) => (state)

VaccinationAppointment:

(appointment_id, center_id) => (date, center_name, current, receiver_phn)

(center_id) => (centerName)

Vaccine:

(name) => (vaccine_type, number_of_shots, cooldown_days, manufacturer_name)

(manufacturer_name) => (name, vaccine_type, number_of_shots, cooldown_days)

VaccineReceiver:

(phn) => (name, email, phone_number, date_of_birth, postal_code)

HealthWorker:

(phn) => (name, email)

SideEffectHappenedToVaccineReceiver:

(receiver_phn, body_part, complaint) => (date_of_complaint)

VaccineRecieverGetsShotVaccine:

(receiver_phn, vaccine_name, shot_time) => (appointment_id, center_id, healthWorker_phn)

(appointment_id, center_id) => (receiver_phn, vaccine_name, shot_time, healthWorker_phn)

VaccinationCenterInventoriesVaccine:

(center_id, vaccine_name) => (amount)

SideEffect

Only FD that exists is trivial.

VaccineHasSideEffect:

Only FD that exists is trivial

5.

VaccineManufacturer:
In BCNF
VaccineManufacturer(
      <u>manufacturer_name</u> CHAR(32),
      production_volume INTEGER,
      production_rate INTEGER
)
##CANDIDATE KEYS:
      -(manufacturer_name)

VaccineOrder:
In BCNF
VaccineOrder(
  <u>order_id</u> INTEGER,
  <u>manufacturer_name</u> CHAR(32),
  center_id INTEGER NOT NULL,
  order_amount INTEGER,
  order_date DATETIME,
)
##CANDIDATE KEYS:
      -(order_id, manufacturer_name)

VaccinationCenter:
In 2NF [(postal_code) => (state) violates BCNF]
VaccinationCenter(
  <u>center_id</u> INTEGER,
  name CHAR(32),
  address CHAR(32),
  postal_code CHAR(7),
  state CHAR(32),
);
##CANDIDATE KEYS:
      -(address, postal_code)
      -(center_id)

AFTER NORMALIZATION
In BCNF
VaccinationCenter(
  <u>center_id</u> INTEGER,
  name CHAR(32),
  address CHAR(32),
  postal_code CHAR(7),

);
##CANDIDATE KEYS:
        -(address, postal_code)
        -(center_id)

PostalCodeState(
        postal_code CHAR(7)
        state CHAR(32)
)
##CANDIDATE KEYS:
        -(postal_code)

VaccinationAppointment:
In 2NF [(center_id) => (centerName) violates BCNF]
VaccinationAppointment(
  appointment_id INTEGER,
  center_id INTEGER,
  date DATETIME,
  center_name CHAR(128),
  current BOOLEAN,
  receiver_phn BIGINT NOT NULL
)
##CANDIDATE KEYS:
        -(appointment_id)

AFTER NORMALIZATION
In BCNF [VaccinationCenter already has the FD (center_id) => (centerName) therefore no additional tables needed]
VaccinationAppointment(
  appointment_id INTEGER,
  center_id INTEGER,
  date DATETIME,
  current BOOLEAN,
  receiver_phn BIGINT NOT NULL
)
##CANDIDATE KEYS:
        -(appointment_id)

Vaccine:
In BCNF
Vaccine(
  name CHAR(25),
  vaccine_type CHAR(32),

```
    number_of_shots INTEGER,
    cooldown_days INTEGER,
    manufacturer_name CHAR(32) UNIQUE
)
##CANDIDATE KEYS:
        -(name)
        -(manufacturer_name)
```

VaccineReceiver:
In BCNF
```
VaccineReceiver(
    phn BIGINT,
    name CHAR(32),
    email CHAR(40),
    phone_number BIGINT,
    date_of_birth DATE,
    postal_code CHAR(7)
)
##CANDIDATE KEYS:-
        -(phn)
```

HealthWorker:
In BCNF
```
HealthWorker(
    phn BIGINT,
    name CHAR(40),
    email CHAR(40)
)
##CANDIDATE KEYS:-
        -(phn)
```

SideEffect:
In BCNF
```
SideEffect(
    body_part CHAR(40),
    complaint CHAR(50),
)
##CANDIDATE KEYS:-
        -(body_part, complaint)
```

SideEffectHappenedToVaccineReceiver:
In BCNF
```
SideEffectHappenedToVaccineReceiver(
    receiver_phn BIGINT,
```

   body_part CHAR(40),
   complaint CHAR(50),
   date_of_complaint DATE
)
##CANDIDATE KEYS:-
       -(receiver_phn **,** body_part, complaint)

VaccineRecieverGetsShotVaccine:
In BCNF
VaccineRecieverGetsShotVaccine(
   receiver_phn BIGINT NOT NULL,
   vaccine_name CHAR(50) NOT NULL,
   shot_time DATETIME,
   healthWorker_phn BIGINT NOT NULL,
   appointment_id INTEGER,
   center_id INTEGER
)
##CANDIDATE KEYS:-
       -(receiver_phn**,** vaccine_name, shot_time)
       -(appointment_id**,** center_id)

VaccineHasSideEffect:
In BCNF
VaccineHasSideEffect(
   vaccine_name CHAR(25),
   body_part CHAR(40),
   complaint CHAR(50),
)
##CANDIDATE KEYS:-
       -(vaccine_name, body_part, complaint)

VaccinationCenterInventoriesVaccine:
In BCNF
VaccinationCenterInventoriesVaccine(
   center_id INTEGER,
   vaccine_name CHAR(25),
   amount INTEGER,
)
##CANDIDATE KEYS:-
       -(center_id, vaccine_name)

6.

```sql
CREATE TABLE VaccineManufacturer(
    manufacturer_name CHAR(32),
    production_volume INTEGER,
    production_rate INTEGER,
    PRIMARY KEY (manufacturer_name)
);

CREATE TABLE VaccineReceiver(
    phn BIGINT,
    name CHAR(32),
    email CHAR(40),
    phone_number BIGINT,
    date_of_birth DATE,
    postal_code CHAR(7),
    PRIMARY KEY (phn)
);

CREATE TABLE HealthWorker(
    phn BIGINT,
    name CHAR(40),
    email CHAR(40),
    PRIMARY KEY (phn)
);

CREATE TABLE Vaccine(
    name CHAR(25),
    vaccine_type CHAR(32),
    number_of_shots INTEGER,
    cooldown_days INTEGER,
    manufacturer_name CHAR(32) UNIQUE NOT NULL,
    PRIMARY KEY (name),
    FOREIGN KEY (manufacturer_name) REFERENCES VaccineManufacturer(manufacturer_name) ON
DELETE NO ACTION ON UPDATE CASCADE
);

CREATE TABLE VaccinationCenter(
    center_id INTEGER,
    name CHAR(32),
    address CHAR(32),
    postal_code CHAR(7),
    state CHAR(32),
    PRIMARY KEY (center_id)
);
```

```
CREATE TABLE VaccineOrder(
    order_id INTEGER,
    manufacturer_name CHAR(32),
    center_id INTEGER NOT NULL,
    order_amount INTEGER,
    order_date DATETIME,
    PRIMARY KEY (order_id, manufacturer_name),
    FOREIGN KEY (manufacturer_name) REFERENCES VaccineManufacturer(manufacturer_name) ON
DELETE CASCADE ON UPDATE CASCADE,
    FOREIGN KEY (center_id) REFERENCES VaccinationCenter(center_id) ON DELETE NO ACTION
ON UPDATE CASCADE
);

CREATE TABLE VaccinationAppointment(
    appointment_id INTEGER,
    center_id INTEGER,
    date DATETIME,
    center_name CHAR(128),
    current BOOLEAN,
    receiver_phn BIGINT NOT NULL,
    PRIMARY KEY (appointment_id, center_id),
    FOREIGN KEY (center_id) REFERENCES VaccinationCenter(center_id) ON DELETE CASCADE
ON UPDATE CASCADE,
    FOREIGN KEY (receiver_phn) REFERENCES VaccineReceiver(phn) ON DELETE NO ACTION
ON UPDATE CASCADE
);

CREATE TABLE SideEffect(
    body_part CHAR(40),
    complaint CHAR(50),
    PRIMARY KEY (body_part, complaint)
);

CREATE TABLE SideEffectHappenedToVaccineReceiver(
    receiver_phn BIGINT,
    body_part CHAR(40),
    complaint CHAR(50),
    date_of_complaint DATE,
    PRIMARY KEY (receiver_phn, body_part, complaint),
    FOREIGN KEY (receiver_phn) REFERENCES VaccineReceiver(phn) ON DELETE CASCADE ON
UPDATE CASCADE,
    FOREIGN KEY (body_part, complaint) REFERENCES SideEffect(body_part, complaint) ON
DELETE CASCADE ON UPDATE CASCADE );
```

```sql
CREATE TABLE VaccineHasSideEffect(
        vaccine_name CHAR(25),
    body_part CHAR(40),
    complaint CHAR(50),
    PRIMARY KEY (vaccine_name, body_part, complaint),
    FOREIGN KEY (vaccine_name) REFERENCES Vaccine(name) ON DELETE CASCADE ON
UPDATE CASCADE,
    FOREIGN KEY (body_part, complaint) REFERENCES SideEffect(body_part, complaint) ON
DELETE CASCADE ON UPDATE CASCADE
);

CREATE TABLE VaccineRecieverGetsShotVaccine(
    receiver_phn BIGINT,
    vaccine_name CHAR(50),
    shot_time DATETIME,
    healthWorker_phn BIGINT NOT NULL,
    appointment_id INTEGER NOT NULL UNIQUE,
    center_id INTEGER NOT NULL UNIQUE,
    PRIMARY KEY (receiver_phn, vaccine_name, shot_time),
    FOREIGN KEY (receiver_phn) REFERENCES VaccineReceiver(phn) ON DELETE NO ACTION
ON UPDATE CASCADE,
    FOREIGN KEY (vaccine_name) REFERENCES Vaccine(name) ON DELETE NO ACTION ON
UPDATE CASCADE,
    FOREIGN KEY (appointment_id, center_id) REFERENCES
VaccinationAppointment(appointment_id, center_id) ON DELETE NO ACTION ON UPDATE NO
ACTION,
    FOREIGN KEY (healthWorker_phn) REFERENCES HealthWorker(phn) ON DELETE NO ACTION
ON UPDATE CASCADE
);

CREATE TABLE VaccinationCenterInventoriesVaccine(
        center_id INTEGER,
    vaccine_name CHAR(25),
    amount INTEGER,
    PRIMARY KEY (center_id, vaccine_name),
    FOREIGN KEY (center_id) REFERENCES VaccinationCenter(center_id) ON DELETE CASCADE
ON UPDATE CASCADE,
    FOREIGN KEY (vaccine_name) REFERENCES Vaccine(name) ON DELETE CASCADE ON
UPDATE CASCADE
)
```

7.

HealthWorker

	phn	name	email
▶	1887737737	Susan Milheimer	susan.milheimer@nasa.com
	5363822534	Heather Mer	evilslayer99@hotmail.com
	6238222152	Peter Geoff	geoff.peter@gmail.com
	7338621983	John	john@gmail.com
	9239633877	Tyler Egg	tyler.egg@gmail.com
*	NULL	NULL	NULL

SideEffect

	body_part	complaint
▶	arm	armache
	arm	swollen
	head	stroke
	heart	heart attack
	lung	blood clot
*	NULL	NULL

SideEffectHappenedToVaccineReceiver

	receiver_phn	body_part	complaint	date_of_complaint
▶	1239633877	heart	heart attack	2021-11-18
	5238222152	arm	armache	2021-12-27
	6363822534	lung	blood clot	2021-12-09
	7887737737	head	stroke	2021-04-12
	9338621983	arm	armache	2021-08-24
*	NULL	NULL	NULL	NULL

VaccinationAppointment

	appointment_id	center_id	date	center_name	current	receiver_phn
▶	1	1	2021-04-12 13:12:00	camche	1	7887737737
	2	1	2021-04-12 14:12:00	camche	0	7887737737
	3	2	2021-09-02 15:00:00	bc place	1	6363822534
	4	5	2021-02-24 12:00:00	staples center	1	5238222152
	5	3	2021-08-06 10:38:00	oracle arena	1	9338621983
*	NULL	NULL	NULL	NULL	NULL	NULL

VaccinationCenter

	center_id	name	address	postal_code	state
▶	1	telus center	2105 57th Ave	V6C 9A2	BC
	2	bc place	240 25th Ave	V6G 7B8	BC
	3	oracle arena	457 20th Ave	V6J 5C4	BC
	4	vancouver general hospital	152 2nd Street	V6C 6S7	BC
	5	staples center	686 4th Street	V6K 1X1	BC
*	NULL	NULL	NULL	NULL	NULL

VaccinationCenterInventoriesVaccine

center_id	vaccine_name	amount
1	comirnaty	60
2	janssen	100
3	merck	1500
4	spikevax	5
5	vaxzevria	24
NULL	NULL	NULL

Vaccine

name	vaccine_type	number_of_shots	cooldown_days	manufacturer_name
comirnaty	mrna	3	20	veler
janssen	adenovirus vector	1	60	camche
merck	mrna	1	36	pontel
spikevax	mrna	2	53	haxola
vaxzevria	adenovirus vector	2	45	dartis
NULL	NULL	NULL	NULL	NULL

VaccineHasSideEffect

vaccine_name	body_part	complaint
merck	arm	armache
vaxzevria	arm	armache
comirnaty	head	stroke
spikevax	heart	heart attack
janssen	lung	blood clot
NULL	NULL	NULL

VaccineManufacturer

manufacturer_name	production_volume	production_rate
camche	40000	600
dartis	30000	500
haxola	16000	900
pontel	15000	800
veler	100000	1000
NULL	NULL	NULL

VaccineOrder

order_id	manufacturer_name	center_id	order_amount	order_date
100	camche	1	500	2021-05-18 13:00:00
100	pontel	2	400	2021-08-01 07:00:00
102	dartis	2	300	2021-04-06 07:00:00
103	haxola	3	250	2021-01-31 20:00:00
105	veler	5	350	2021-09-21 06:00:00
NULL	NULL	NULL	NULL	NULL

VaccineReceiver

	phn	name	email	phone_number	date_of_birth	postal_code
►	1239633877	Tyler Johnson	tyler0101@tylerjohnson.com	7782426283	2001-01-01	V6J 5C4
	5238222152	Peter Kae	peter.kae@gmail.com	4037847382	1988-04-26	V6C 9A2
	6363822534	Heather Heatherson	heather@gmail.com	6042628282	1955-11-24	V6G 7B8
	7887737737	Susan Neige	susanneige@gmail.com	6043692375	1997-04-12	V6X 1X1
	9338621983	John Brown	johnbrown@hotmail.com	7785362894	1982-01-04	V6C 6S7
*	NULL	NULL	NULL	NULL	NULL	NULL

VaccineReceiverGetsShotVaccine

	receiver_phn	vaccine_name	shot_time	healthWorker_phn	appointment_id	center_id
►	1239633877	vaxzevria	2021-08-06 10:49:00	9239633877	5	3
	5238222152	spikevax	2021-02-24 12:04:00	7338621983	4	5
	6363822534	merck	2021-09-02 15:03:00	6238222152	3	2
	7887737737	janssen	2021-04-12 14:15:00	5363822534	2	1
	9338621983	comirnaty	2021-04-12 13:13:00	1887737737	1	1
*	NULL	NULL	NULL	NULL	NULL	NULL

8.

INSERTION: Record a vaccination shot of a particular vaccine to a particular person, done by health worker, during a vaccination appointment at a particular vaccination center

UPDATE: Update the vaccine inventory of a vaccine center

DELETION: Remove a vaccine appointment previously scheduled by a vaccine receiver

SELECTION: Select all the people who have a side effect in their arm during Summer

PROJECTION: (" We haven't learnt this in class yet")

JOIN: (" We haven't learnt this in class yet")

AGGREGATION WITH GROUP BY: (" We haven't learnt this in class yet")

AGGREGATION WITH HAVING: (" We haven't learnt this in class yet")

NESTED AGGREGATION WITH GROUP BY: (" We haven't learnt this in class yet")

DIVISION: (" We haven't learnt this in class yet")