INFS7901 Formal Specification

Project Description

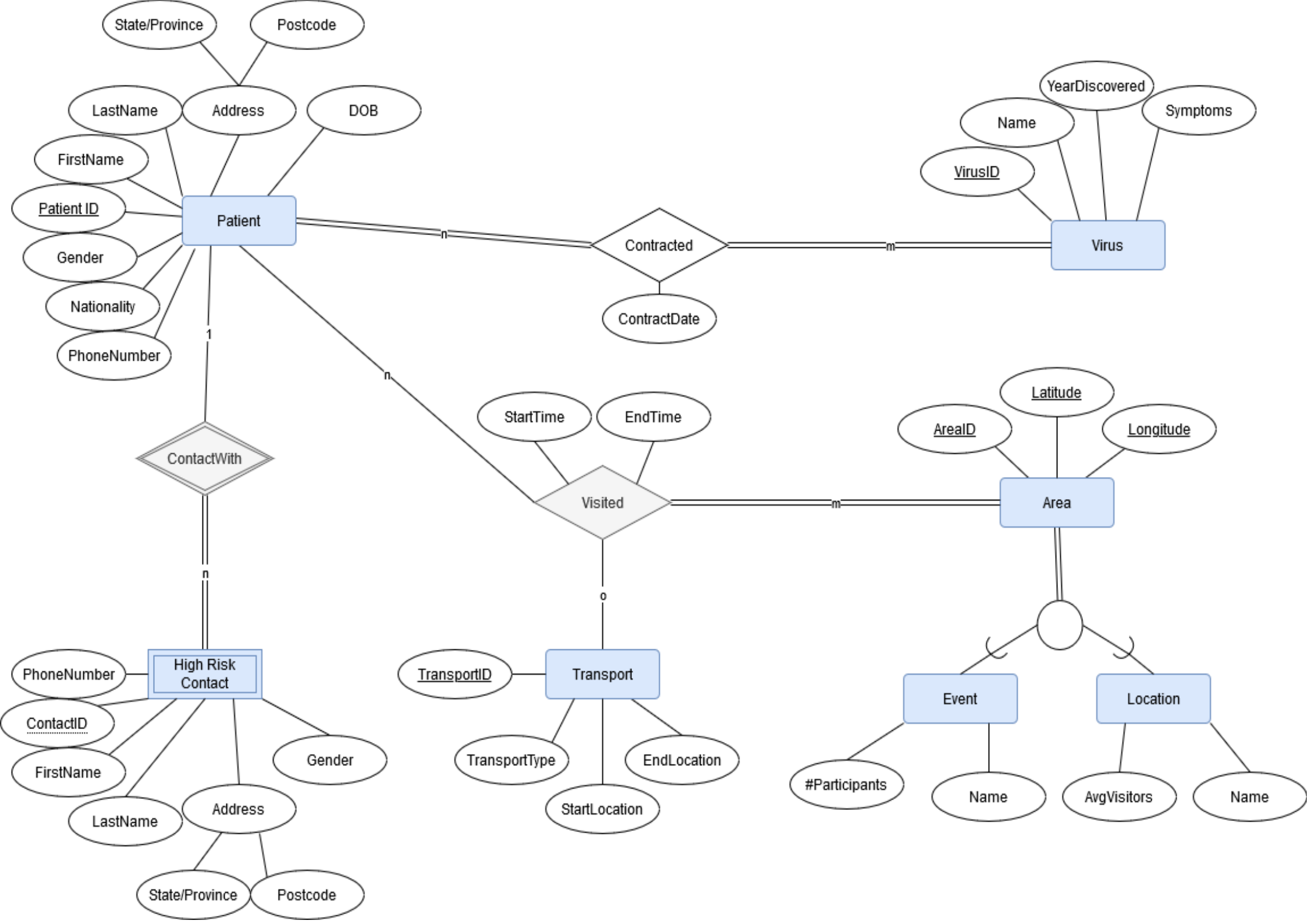
In this project, the records of human movement in a pandemic will be stored in a relational database. The dataset will focus on human contact and movement. The aim is to improve the speed and accuracy of tracing contraction routes of infectious diseases.

The main functionality of this system is to provide users personal information on patients and a history of where they visited recently. Users can quickly identify where the patient was at what time. Additionally, information on people that have been in close contact with the patient will be stored as well. The end-goal of the project is a map-like functionality where users can see (or query) where confirmed cases of infectious diseases have occurred.

Updated E/R Diagram

Several aspects have been updated since the project proposal.

- Added a 'Phone Number' attribute for entity 'Patient' and 'High Risk Contact'.
- Changed the 'Address' attribute for entity 'High Risk Contact' to be a complex attribute.
- Removed 'TimeRange' attribute from entity 'Area' and 'Transport'. Added attributes 'StartTime' and 'EndTime' on the relationship 'Visited'. This is to remove duplicate area entries with different "TimeRange".
- Underlined all composite keys
- Removed attributes "Underlying condition" and "CurrentCondition" as it was out of scope for this project's functionality.
- The participation constraint for entity "Transport" in relation "Visited" have been changed to "partial". This is to allow for travel instances where the transport method is unknown, or if the method has minimal risk in spreading a disease (e.g. walking).


State/Province
Postcode
LastName
Address
DOB
FirstName
Patient ID
Patient
Gender
Nationality
PhoneNumber
1
n
Contracted
ContractDate
m
YearDiscovered
Name
Symptoms
VirusID
Virus
n
ContactWith
StartTime
EndTime
Visited
m
Latitude
AreaID
Longitude
Area
n
o
PhoneNumber
High Risk Contact
ContactID
FirstName
LastName
Address
Gender
State/Province
Postcode
TransportID
Transport
TransportType
EndLocation
StartLocation
Event
Location
#Participants
Name
AvgVisitors
Name

Schema:

Relations:

PATIENT(PatientID, FirstName, LastName, Gender, Nationality, State/Province, Postcode, DOB, PhoneNumber)

VIRUS(VirusID, Name, Year Discovered, Symptoms)

TRANSPORT(TransportID, TransportType, StartLocation, EndLocation)

HIGH_RISK_CONTACT(PatientID, ContactID, FirstName, LastName, Gender, State/Province, Postcode, PhoneNumber)

CONTRACTED(PatientID, VirusID, ContractDate)

VISITED(PatientID, TransportID, AreaID, StartTime, EndTime)

AREA(AreaID, Latitude, Longitude)

EVENT(AreaID, Name, TotalVisitors)

LOCATION(AreaID, Name, AvgVisitors)

Foreign Keys:

HIGH_RISK_CONTACT.PatientID → PATIENT.PatientID

CONTRACTED.PatientID → PATIENT.PatientID

CONTRACTED.VirusID → PATIENT.VirusID

VISITED.PatientID → PATIENT.PatientID

VISITED.TransportID → TRANSPORT.TransportID

VISITED.AreaID → AREA.AreaID

EVENT.AreaID → AREA.AreaID

LOCATION.AreaID → AREA.AreaID

Functional Dependencies

For table PATIENT:

- PatientID → ALL (The primary key determines all other attributes.)

For table VIRUS:

- VirusID → ALL (The primary key determines all other attributes)

For table TRANSPORT:

- TransportID → ALL (The primary key determines all other attributes)

For table HighRiskContact:

- PatientID, ContactID → ALL (The primary keys determines all other attributes)

For table Contracted:

- PatientID, VirusID → ContractDate (Given Patient ID and Virus ID, we can find out the date when the patient contracted the virus)

For table Visited:

- None (Patient can visit the same area(location) using the same transport at different times.) NOTE: Given patient and StartTime, it may be possible to determine Area, Transport and Endtime. However, StartTime accepts null values and hence FD does not hold.

For table Area:

- None (Different AreaID's can have the same latitude and longitude because different events might be stored in the same location. Therefore, latitude and longitude are candidate keys as well.)

For table Event:

- AreaID → Name, TotalVisitors (Given an AreaID, we can determine the name and the total visitors of an event)

For table Location:

- AreaID → Name, AvgVisitors (Given an AreaID, we can determine the name and the average visitors of a location)

Normalized Schema

Since all the FDs have super keys (primary keys) in the left-hand side, the original schema is already normalized.

SQL dump

```
-- phpMyAdmin SQL Dump
-- version 4.6.6deb5
-- https://www.phpmyadmin.net/
--
-- Host: localhost
-- Generation Time: Apr 12, 2020 at 04:50 AM
-- Server version: 5.7.28-0ubuntu0.18.04.4
-- PHP Version: 7.2.24-0ubuntu0.18.04.2

SET SQL_MODE = "NO_AUTO_VALUE_ON_ZERO";
SET time_zone = "+00:00";


/*!40101 SET @OLD_CHARACTER_SET_CLIENT=@@CHARACTER_SET_CLIENT */;
/*!40101 SET @OLD_CHARACTER_SET_RESULTS=@@CHARACTER_SET_RESULTS */;
/*!40101 SET @OLD_COLLATION_CONNECTION=@@COLLATION_CONNECTION */;
/*!40101 SET NAMES utf8mb4 */;

--
-- Database: `virus_project`
--

-- --------------------------------------------------------

--
-- Table structure for table `Area`
--

CREATE TABLE `Area` (
  `AreaID` int(11) NOT NULL,
  `Latitude` decimal(10,8) DEFAULT NULL,
  `Longitude` decimal(11,8) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Area`
--

INSERT INTO `Area` (`AreaID`, `Latitude`, `Longitude`) VALUES
(2, '-27.48483139', '153.03616652'),
(3, '-37.81866339', '144.98332940'),
(4, '-27.49199803', '153.00766664'),
(5, '-33.85416325', '151.20916583'),
(6, '-33.85597991', '151.20666584'),
(8, '-35.10210000', '139.14240000'),
(9, '-33.86982985', '151.20433252'),
(10, '-33.84166330', '151.05799977'),
(11, '-42.00000000', '147.00000000');

-- --------------------------------------------------------

--
-- Table structure for table `Contracted`
--

CREATE TABLE `Contracted` (
  `PatientID` int(11) NOT NULL,
  `VirusID` int(11) NOT NULL,
  `ContractDate` date DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Contracted`
```

```
--

INSERT INTO `Contracted` (`PatientID`, `VirusID`, `ContractDate`) VALUES
(1, 1, '2020-02-05'),
(1, 2, '2020-01-08'),
(7, 1, '2020-01-23'),
(9, 1, '2020-01-19'),
(2, 1, '2020-02-08'),
(3, 1, '2020-03-04'),
(4, 1, '2020-03-19'),
(5, 1, '2020-01-31'),
(6, 1, '2020-02-18'),
(8, 1, '2020-04-02'),
(10, 1, '2020-02-25');

-- --------------------------------------------------------

--
-- Table structure for table `Event`
--

CREATE TABLE `Event` (
  `AreaID` int(11) NOT NULL,
  `Name` varchar(64) DEFAULT NULL,
  `TotalVisitors` int(11) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Event`
--

INSERT INTO `Event` (`AreaID`, `Name`, `TotalVisitors`) VALUES
(2, '1st Test: Australia v Pakistan (d1)', 13561),
(3, 'AFL: Richmond d Carlton', 21000),
(5, 'Ludovico Einaudi | 20 & 21 Jan', 3577),
(10, 'NRL: Rabbitohs d Sharks', 6235);

-- --------------------------------------------------------

--
-- Table structure for table `HighRiskContact`
--

CREATE TABLE `HighRiskContact` (
  `ContactID` int(11) NOT NULL,
  `PatientID` int(11) NOT NULL,
  `FirstName` varchar(32) DEFAULT NULL,
  `LastName` varchar(32) DEFAULT NULL,
  `Gender` enum('m','f') DEFAULT NULL,
  `State` varchar(32) DEFAULT NULL,
  `Postcode` varchar(16) DEFAULT NULL,
  `PhoneNumber` char(10) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `HighRiskContact`
--

INSERT INTO `HighRiskContact` (`ContactID`, `PatientID`, `FirstName`, `LastName`, `Gender`, `State`, `Postcode`, `PhoneNumber`) VALUES
(1, 1, 'Yuri', 'Thompson', 'f', 'Queensland', '4350', '0404638492'),
(2, 1, 'Roland', 'Thompson', 'm', 'Queensland', '4350', '0746356208'),
(3, 1, 'Jesse', 'Brock', 'm', 'South Australia', '5000', '0882530494'),
(4, 2, 'Jessica', 'Masters', 'f', 'New South Wales', '2000', '0281035235'),
(5, 2, 'Alexis', 'Guy', 'm', 'New South Wales', '2000', '0286491522'),
(6, 4, 'Samantha', 'Kaw', 'f', 'Western Australia', '6743', '0890728189'),
(7, 5, 'Hayley', 'Rimmer', 'f', 'New South Wales', '2551', '0240345203'),
(8, 5, 'Madeline', 'George', 'f', 'New South Wales', '2424', '0249769134'),
(9, 5, 'Charlie', 'Mead', 'm', 'New South Wales', '2800', '0240020278'),
(10, 5, 'Taj', 'Neumayer', 'm', 'New South Wales', '2836', '0240070037'),
(11, 5, 'Noah', 'Livingston', 'm', 'New South Wales', '2790', '0240000554'),
(12, 6, 'Savannah', 'Styles', 'f', 'Queensland', '4600', '0753200261'),
```

```
(13, 6, 'Dylan', 'Bage', 'm', 'Queensland', '4740', '0749393657'),
(14, 7, 'Maya', 'Rudd', 'f', 'Tasmania', '7304', '0362437766'),
(15, 9, 'Archer', 'Braund', 'm', 'South Australia', '5000', '0882092021'),
(16, 10, 'Anthony', 'Leane', 'm', 'Victoria', '3871', '0353156250'),
(17, 10, 'Tayla', 'Sinclaire', 'f', 'Victoria', '3707', '0353244344'),
(18, 10, 'Sean', 'Archibald', 'm', 'Victoria', '3764', '0387977897');

-- --------------------------------------------------------

--
-- Table structure for table `Location`
--

CREATE TABLE `Location` (
  `AreaID` int(11) NOT NULL,
  `Name` varchar(32) DEFAULT NULL,
  `AvgVisitors` int(11) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Location`
--

INSERT INTO `Location` (`AreaID`, `Name`, `AvgVisitors`) VALUES
(4, 'University of Queensland', 9000),
(6, 'International Towers Sydney 1', 4650),
(8, 'Monarto Zoo', 1600),
(9, 'Hilton Hotel Sydney', 200),
(11, 'MONA', 950);

-- --------------------------------------------------------

--
-- Table structure for table `Patient`
--

CREATE TABLE `Patient` (
  `PatientID` int(11) NOT NULL,
  `FirstName` varchar(32) NOT NULL,
  `LastName` varchar(32) NOT NULL,
  `Gender` enum('m','f') NOT NULL,
  `Nationality` varchar(32) DEFAULT NULL,
  `State` varchar(32) DEFAULT NULL,
  `Postcode` int(4) DEFAULT NULL,
  `DOB` date NOT NULL,
  `PhoneNumber` char(10) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Patient`
--

INSERT INTO `Patient` (`PatientID`, `FirstName`, `LastName`, `Gender`, `Nationality`, `State`, `Postcode`, `DOB`, `PhoneNumber`) VALUES
(1, 'Roland', 'Thompson', 'm', 'Australian', 'Queensland', 4170, '1995-09-29', '0411111111'),
(2, 'Mary', 'Winchester', 'f', 'American', 'New South Wales', 2453, '1978-05-18', '0267586000'),
(3, 'Harry', 'Farrar', 'm', 'Australian', 'Northern Territory', 810, '1980-07-31', '0889928309'),
(4, 'Isla', 'Maiden', 'f', 'Canadian', 'Western Australia', 6630, '1995-03-05', '0890917711'),
(5, 'Aidan', 'Isles', 'm', 'English', 'New South Wales', 2872, '1968-04-27', '0282567682'),
(6, 'Eliza', 'Gopinko', 'f', 'Australian', 'Queensland', 4610, '1977-04-07', '0745474645'),
(7, 'Zhong', 'Yang', 'm', 'Chinese', 'Tasmania', 7252, '1979-10-22', '0362773241'),
(8, 'Darcy', 'Lanigan', 'm', 'Australian', 'Queensland', 4352, '1996-12-02', '0745047217'),
(9, 'Lin', 'Wen', 'f', 'Chinese', 'South Australia', 5253, '1985-05-08', '0882785599'),
(10, 'Hannah', 'Hardwick', 'f', 'American', 'Victoria', 3517, '1988-03-27', '0353899611');

-- --------------------------------------------------------

--
-- Table structure for table `Transport`
--

CREATE TABLE `Transport` (
```

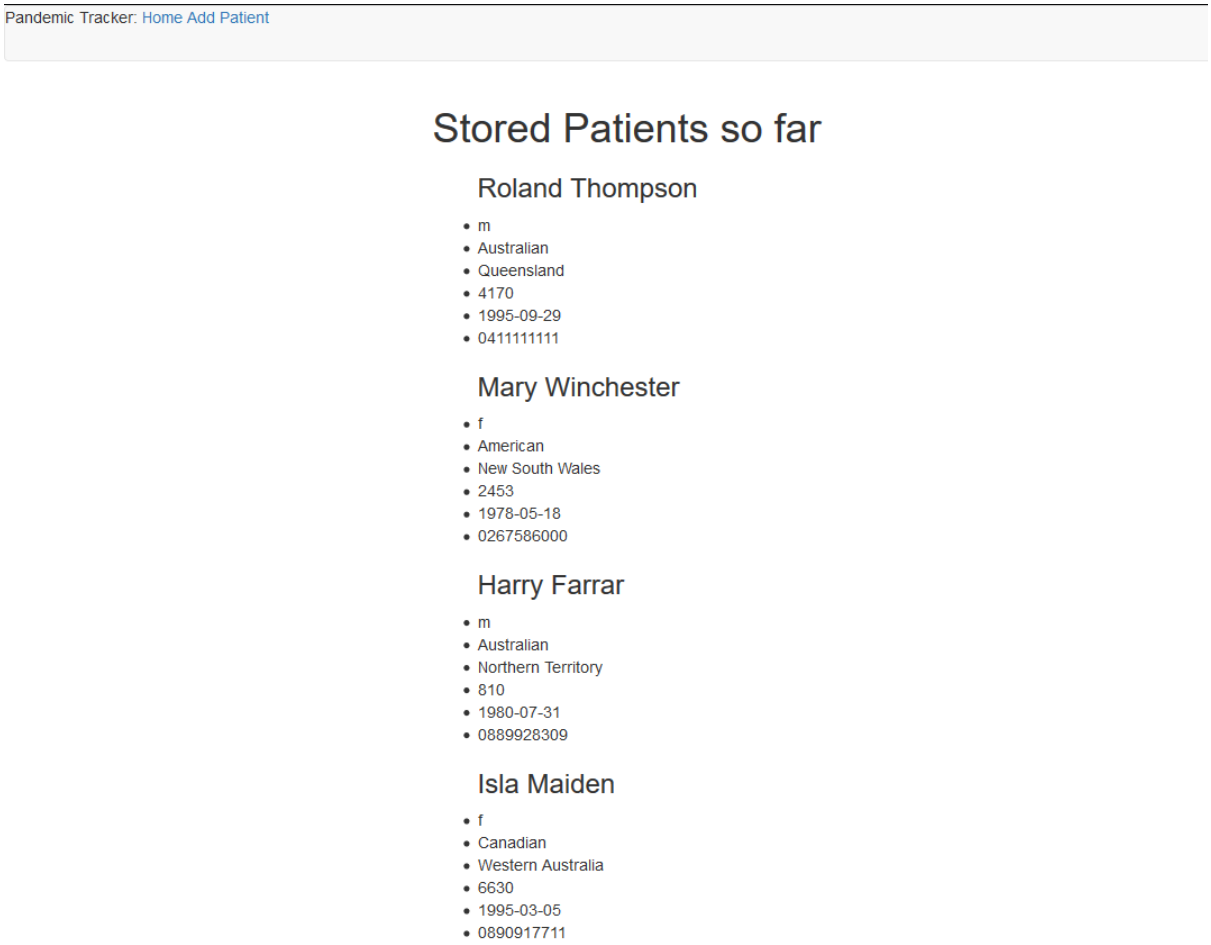
```
  `TransportID` int(11) NOT NULL,
  `TransportType` varchar(16) DEFAULT NULL,
  `StartLocation` varchar(64) DEFAULT NULL,
  `EndLocation` varchar(64) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Transport`
--

INSERT INTO `Transport` (`TransportID`, `TransportType`, `StartLocation`, `EndLocation`) VALUES
(1, 'Airplane', 'Wuhan Tianhe International Airport', 'Sydney Airport'),
(2, 'Airplane', 'Sydney Airport', 'Hobart Airport'),
(3, 'Airplane', 'Sydney Airport', 'Adelaide Airport'),
(4, 'Bus', 'Adelaide Airport', 'Begley Street Busstop'),
(5, 'Train', 'Norman Park Station', 'Park Road Station'),
(6, 'Bus', 'Boggo Road', 'UQ Lakes'),
(7, 'Train', 'Ashfield Station', 'ANZ Stadium Station'),
(8, 'Train', 'Cheltenham Station', 'Flinders Street Station');

-- --------------------------------------------------------

--
-- Table structure for table `Virus`
--

CREATE TABLE `Virus` (
  `VirusID` int(11) NOT NULL,
  `Name` varchar(32) DEFAULT NULL,
  `LastOutbreak` int(11) DEFAULT NULL,
  `Symptoms` varchar(256) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Virus`
--

INSERT INTO `Virus` (`VirusID`, `Name`, `LastOutbreak`, `Symptoms`) VALUES
(1, 'SARS-CoV-2', 2019, 'Fever, cough, shortness of breath'),
(2, 'SARS-CoV-1', 2003, 'Fever, dry cough, headache, muscle aches, shortness of breath'),
(3, 'Swine Influenza', 2009, 'Fever, cough, sore throat, chills, sneezing, runny nose'),
(4, 'Avian influenza', 1918, 'Fever, cough, sore throat, headache, fatigue');

-- --------------------------------------------------------

--
-- Table structure for table `Visited`
--

CREATE TABLE `Visited` (
  `PatientID` int(11) NOT NULL,
  `TransportID` int(11) DEFAULT NULL,
  `AreaID` int(11) NOT NULL,
  `StartTime` datetime DEFAULT NULL,
  `EndTime` datetime DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `Visited`
--

INSERT INTO `Visited` (`PatientID`, `TransportID`, `AreaID`, `StartTime`, `EndTime`) VALUES
(1, 5, 4, '2020-03-01 08:00:00', '2020-03-01 12:00:00'),
(1, 6, 4, '2020-03-01 08:00:00', '2020-03-01 12:00:00'),
(2, 7, 10, '2020-03-14 15:30:00', '2020-03-14 21:00:00'),
(5, 7, 10, '2020-03-14 16:00:00', '2020-03-14 22:30:00'),
(6, NULL, 2, '2020-01-21 09:00:00', '2020-01-21 18:00:00'),
(1, 5, 4, '2020-03-01 08:00:00', '2020-03-01 12:00:00'),
(1, 6, 4, '2020-03-01 08:00:00', '2020-03-01 12:00:00'),
(2, 7, 10, '2020-03-14 15:30:00', '2020-03-14 21:00:00'),
(5, 7, 10, '2020-03-14 16:00:00', '2020-03-14 22:30:00'),
```

```
(6, NULL, 2, '2020-01-21 09:00:00', '2020-01-21 18:00:00'),
(6, NULL, 4, NULL, NULL),
(7, 2, 11, '2020-02-28 13:25:00', '2020-02-28 19:30:00'),
(9, 3, 8, NULL, NULL),
(10, 8, 3, '2020-03-19 18:00:00', '2020-03-19 22:45:00');

--
-- Indexes for dumped tables
--

--
-- Indexes for table `Area`
--
ALTER TABLE `Area`
  ADD PRIMARY KEY (`AreaID`);

--
-- Indexes for table `Contracted`
--
ALTER TABLE `Contracted`
  ADD KEY `PatientID` (`PatientID`),
  ADD KEY `VirusID` (`VirusID`);

--
-- Indexes for table `Event`
--
ALTER TABLE `Event`
  ADD KEY `AreaID` (`AreaID`);

--
-- Indexes for table `HighRiskContact`
--
ALTER TABLE `HighRiskContact`
  ADD PRIMARY KEY (`ContactID`),
  ADD KEY `PatientID` (`PatientID`);

--
-- Indexes for table `Location`
--
ALTER TABLE `Location`
  ADD KEY `AreaID` (`AreaID`);

--
-- Indexes for table `Patient`
--
ALTER TABLE `Patient`
  ADD PRIMARY KEY (`PatientID`);

--
-- Indexes for table `Transport`
--
ALTER TABLE `Transport`
  ADD PRIMARY KEY (`TransportID`);

--
-- Indexes for table `Virus`
--
ALTER TABLE `Virus`
  ADD PRIMARY KEY (`VirusID`);

--
-- Indexes for table `Visited`
--
ALTER TABLE `Visited`
  ADD KEY `PatientID` (`PatientID`),
  ADD KEY `TransportID` (`TransportID`),
  ADD KEY `AreaID` (`AreaID`);

--
-- AUTO_INCREMENT for dumped tables
--
```

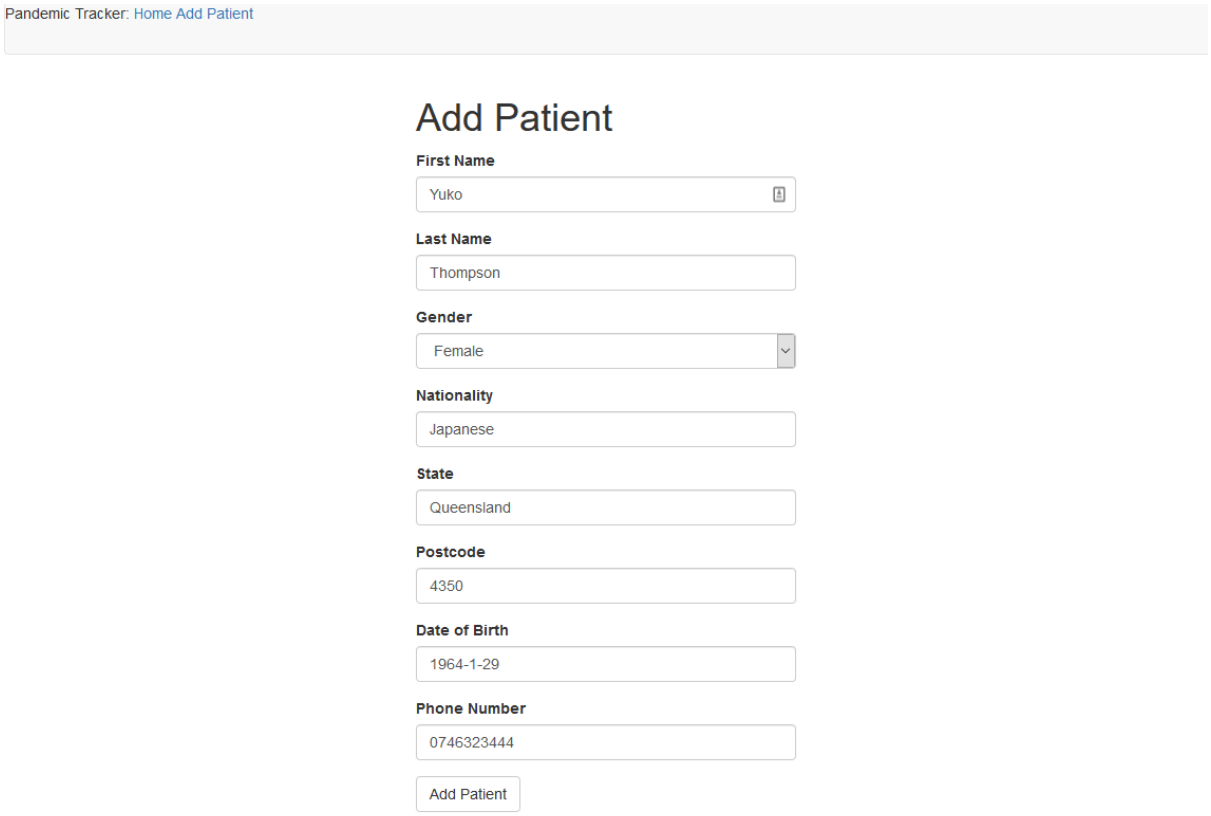
```
--
-- AUTO_INCREMENT for table `Area`
--
ALTER TABLE `Area`
  MODIFY `AreaID` int(11) NOT NULL AUTO_INCREMENT, AUTO_INCREMENT=12;
--
-- AUTO_INCREMENT for table `HighRiskContact`
--
ALTER TABLE `HighRiskContact`
  MODIFY `ContactID` int(11) NOT NULL AUTO_INCREMENT, AUTO_INCREMENT=19;
--
-- AUTO_INCREMENT for table `Patient`
--
ALTER TABLE `Patient`
  MODIFY `PatientID` int(11) NOT NULL AUTO_INCREMENT, AUTO_INCREMENT=11;
--
-- AUTO_INCREMENT for table `Transport`
--
ALTER TABLE `Transport`
  MODIFY `TransportID` int(11) NOT NULL AUTO_INCREMENT, AUTO_INCREMENT=9;
--
-- AUTO_INCREMENT for table `Virus`
--
ALTER TABLE `Virus`
  MODIFY `VirusID` int(11) NOT NULL AUTO_INCREMENT, AUTO_INCREMENT=5;
--
-- Constraints for dumped tables
--

--
-- Constraints for table `Contracted`
--
ALTER TABLE `Contracted`
  ADD CONSTRAINT `Contracted_ibfk_1` FOREIGN KEY (`PatientID`) REFERENCES `Patient` (`PatientID`),
  ADD CONSTRAINT `Contracted_ibfk_2` FOREIGN KEY (`VirusID`) REFERENCES `Virus` (`VirusID`);

--
-- Constraints for table `Event`
--
ALTER TABLE `Event`
  ADD CONSTRAINT `Event_ibfk_1` FOREIGN KEY (`AreaID`) REFERENCES `Area` (`AreaID`);

--
-- Constraints for table `HighRiskContact`
--
ALTER TABLE `HighRiskContact`
  ADD CONSTRAINT `HighRiskContact_ibfk_1` FOREIGN KEY (`PatientID`) REFERENCES `Patient` (`PatientID`);

--
-- Constraints for table `Location`
--
ALTER TABLE `Location`
  ADD CONSTRAINT `Location_ibfk_1` FOREIGN KEY (`AreaID`) REFERENCES `Area` (`AreaID`);

--
-- Constraints for table `Visited`
--
ALTER TABLE `Visited`
  ADD CONSTRAINT `Visited_ibfk_1` FOREIGN KEY (`PatientID`) REFERENCES `Patient` (`PatientID`),
  ADD CONSTRAINT `Visited_ibfk_2` FOREIGN KEY (`TransportID`) REFERENCES `Transport` (`TransportID`),
  ADD CONSTRAINT `Visited_ibfk_3` FOREIGN KEY (`AreaID`) REFERENCES `Area` (`AreaID`);

/*!40101 SET CHARACTER_SET_CLIENT=@OLD_CHARACTER_SET_CLIENT */;
/*!40101 SET CHARACTER_SET_RESULTS=@OLD_CHARACTER_SET_RESULTS */;
/*!40101 SET COLLATION_CONNECTION=@OLD_COLLATION_CONNECTION */;
```

Screenshots of progress:

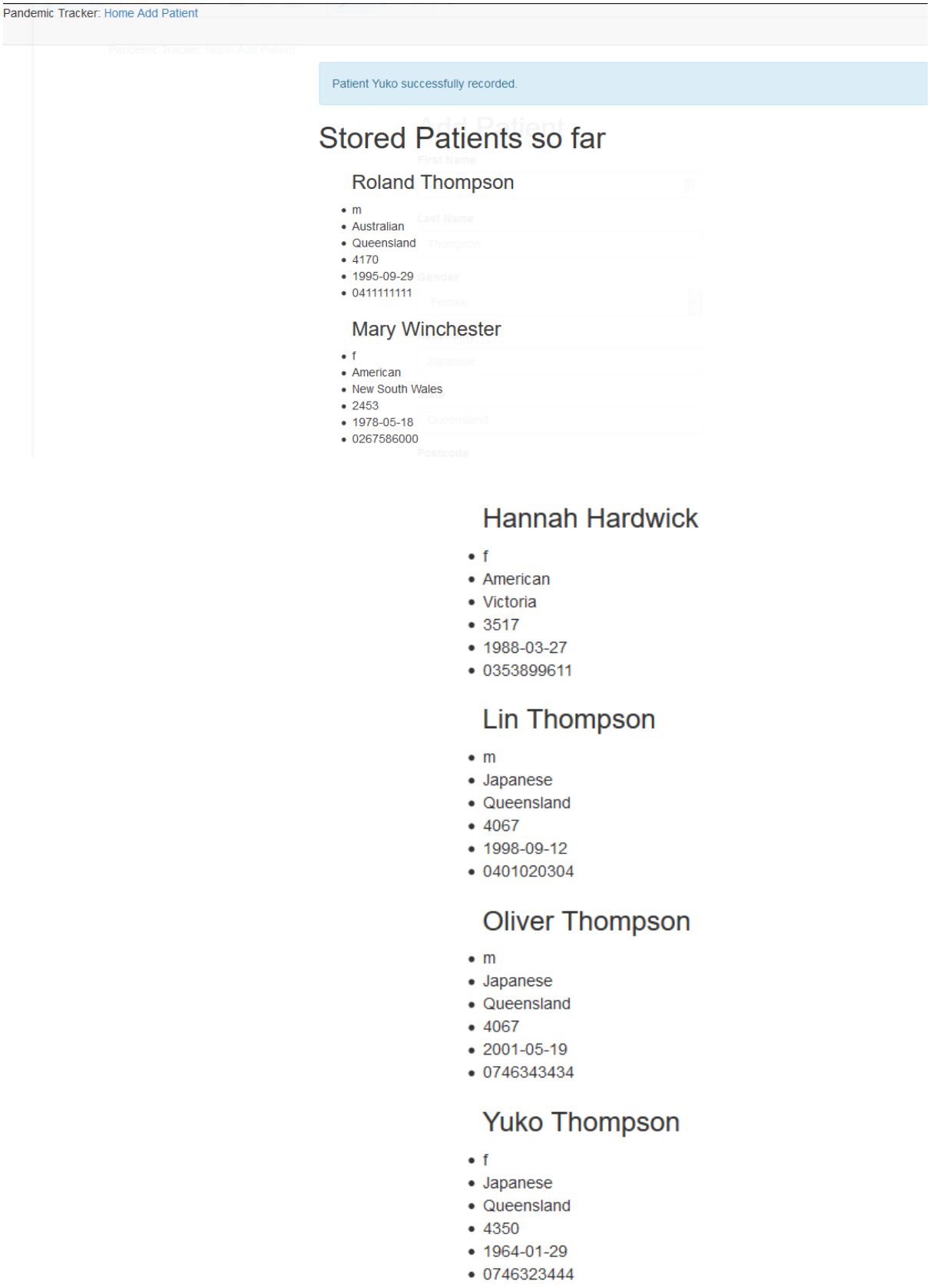
SELECT * FROM PATIENTS



Add patient form, performing an INSERT query

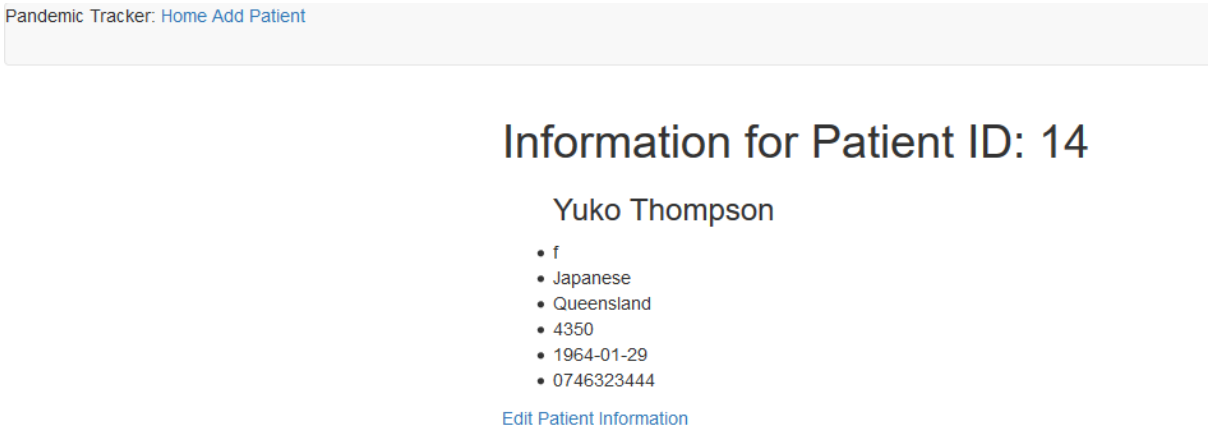


Added patients

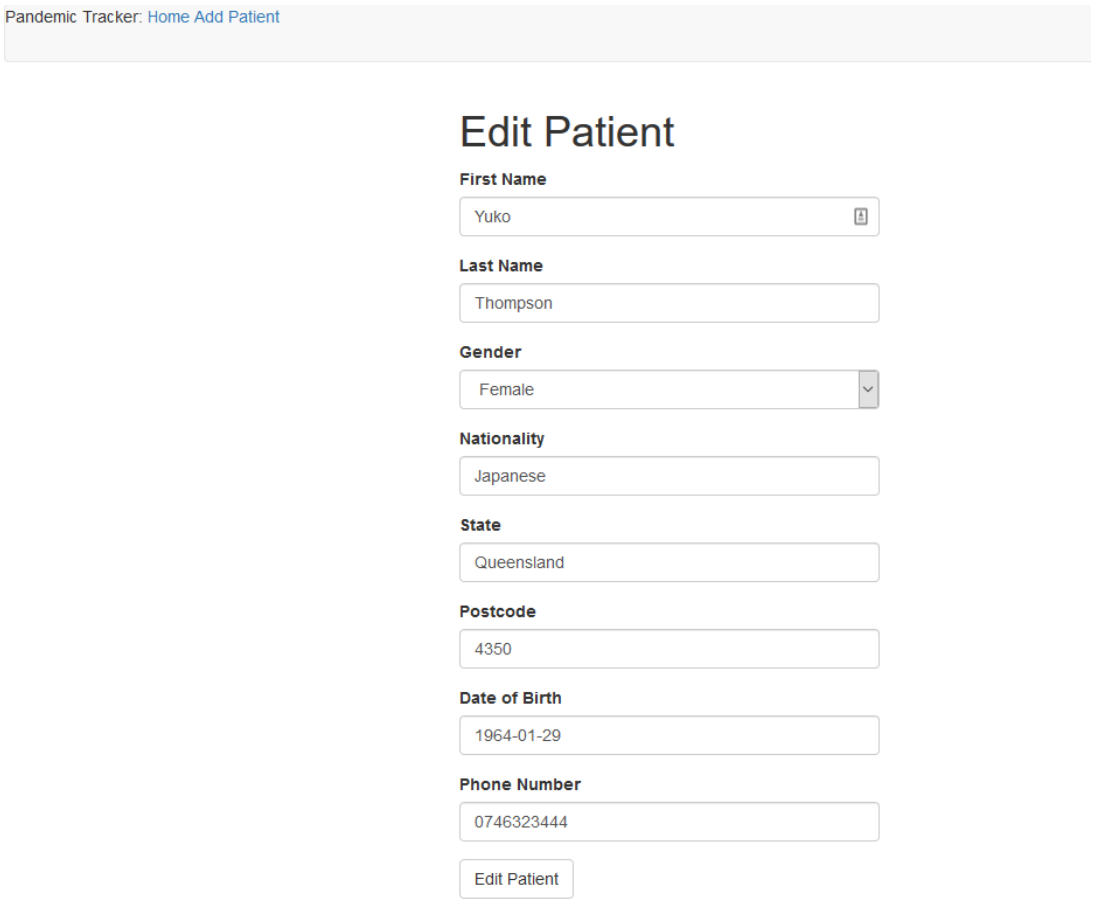


Detail page (patient)

SELECT * FROM Patient WHERE PatientID = 14



Edit page (patient), pre-filled with existing information



Patient Information after editing using the UPDATE query