

# Integrated Quality Database



## Internship Report



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In partial fulfillment of the requirements of the Master  
of Health Informatics  
Program

Dalhousie University

Report of Internship for the period May 15, 2017 to  
August 18, 2017

Date Submitted: August 18, 2017

This report has been written by me and  
has not received any previous academic credit  
at this or any other institution

I would like to thank

Ms. Jan Jenson,  
Mr. Jonathan Flynn,  
Mr. Ehsan Maghsoud-lou,  
Mr. Delbert Kenley,  
Mr. Ryan Langille,  
Ms. Jennifer Rose,  
Ms. Crystal Fitzgerald,  
Mr. Judah Goldstein  
Ms. Mary Kate Needler  
Mr. Chris Lukeman  
Ms. Carly Collings-Robertson

for their support and for sharing their knowledge and experience with me.

A handwritten signature in black ink, appearing to be 'Arman Izadi', with a stylized 'A' and 'I'.

Arman Izadi

## Executive Summary

**The organization:** EMC provides ground and air ambulance services to Nova Scotians in emergencies. The services range from basic to advanced life support. Telehealth (811) is also part of this company which provides medical consultation to Nova Scotians for non-emergency conditions.

**The internship work:** Since the organization uses several different solutions that are not standard and cannot exchange data with each other, different departments should query the databases and review and approve the data, according to their reporting needs. Creating a database to integrate the data from different sources (internal and external), so that, the records could be reviewed only once (not several times by different departments) was the main purpose of the project. I was responsible for requirement assessment, planning, categorization of data, database design and implementation, as well as documentation. I created a relational database in SQL Server with about 70 tables (including the reference tables) that could meet their reporting needs, primarily for cardiac arrest cases, but I designed the structure of the database in a way that other conditions can also be added if needed.

### **How the internship work relates to health informatics**

The project was related to most of the courses in the master of health informatics program, including, project management, health information flow and use, flow and standards, systems and issues, as well as networks and web. The project management course helped me develop a plan for the project, using Microsoft Project. The health information flow and use, and the flow and standards courses made it possible for me to develop a storyboard, recognize the processes, assess the work flow, and understand the indicators. The systems and issues course helped me with the data flow and systems boundaries. Finally, the networks and web helped me identify the entities, categorize the data and the tables, build a logical relationship between the tables and design the database. Querying the existing sources of data helped me in determining the data types and the possible values for each attribute and creating the reference tables.

### **The problems in EMC that merits a health informatics solution**

The main problem is that the software solutions that are used in the company are neither logically related nor standard (lack of interoperability). Reporting and conducting research requires a combination of automatic integration of data from some sources and manual data entry from other sources, as well as manual editing and approval of the integrated data which is labor-intensive. In addition, there are many fields in the application where user errors could be limited but they have been ignored by the vendors. Users have to type in the textboxes in the applications and the user errors have significantly affected the validity of the stored data. The same problem is seen with health card numbers, which are manually entered and card scanners are not used.

### **Conclusion**

The future solutions should see EHS companies as one system and extend the boundaries of their systems or be able to exchange data automatically within the organization. An effective system enables the company to schedule shifts according to availability of the paramedics (the administration system) and the ambulances (the fleet maintenance system), and provide a logical relationship between the computer-assisted dispatch system (CAD) and the electronic patient care record (ePCR), while facilitating transfer of data from defibrillation devices and other subsystems. The current systems are not standard and cannot

exchange data with external entities. Integrating the existing solutions as well as using standard semantic codes for data exchange is one of the options. The software companies should try to limit user errors by creating reference tables from historical data or scientific resources, and by using other methods such as card scanners. Some of the current software solutions are not user-friendly and the companies should try to customize their solutions according to the type of the service.

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## 1. Introduction

As someone who had experience in emergency and disaster management, clinical practice and health informatics, I applied for an internship position in the Emergency Medical Care Incorporation (EMC Inc.) which is responsible for emergency medical services throughout the province of Nova Scotia. Fortunately they needed a health informatician for a project and I was hired. The problem was that they had several different solutions, such as computer-assisted dispatch (CAD) system for their communication center, and electronic patient care records (ePCR) system for their response, and it was hard for them to integrate and clean the data for aggregate reports and research. Different departments used to do these tasks separately and the process was labor-intensive and lengthy. The solution was to create an integrated quality database (IQDB), so that, any record could be assessed and cleaned only once and authorized entities could have access to the approved data for reporting and research purposes. My responsibility was to develop a plan for the project, and design and build the integrated quality database after need assessment.

(All the figures and tables in this report are made by me. The pictures related to the services of the company are copied from the internet and companies website)

### References:

1. Christopher Allen (2004), Introduction to relational databases and SQL programming, McGraw Hill Technology Education Burr Ridge, IL
2. Ray Dawson (2001), Relational databases: design and use, Group D Publications Loughborough
3. [www.emci.ca](http://www.emci.ca)

## 2. Description of the organization

### 2.1. Emergency Medical Care Inc. (EMC)

EMC is a privately company that provides emergency health services (EHS) throughout Nova Scotia. They are the only EHS company in the province. Their services include ground and air ambulance, telehealth medical communications, and the medical communications center in Nova Scotia. They have more than 1,400 employees including highly-trained paramedics, nurses, medical communication officers and support staff. Their budget is provided through a long-term performance-based contract with the provincial government. EMC responds to about 160,000 cases annually. They have more than 180 ambulances and support vehicles operating in about 60 stations.

### 2.2. EMC Services

#### 2.2.1. Ground Ambulance:

After a person calls 911 for medical help, the caller is redirected to the Medical Communications Centre (MCC) which is the first point of contact for most people across the province. The medical communication officers assess the problem and the location, and notify dispatchers to dispatch a suitable response unit immediately.

The response units (at least two paramedics and an ambulance) have different levels according to the level of education of the paramedics. Some are for critical cases and advanced life support, while others serve non-emergency cases.



#### 2.2.2. LifeFlight

The first response on the ground is almost always by ground ambulances. Air ambulances sometimes are needed and they work closely with ground ambulances to transport patients to health care facilities in emergency and critical situations. LifeFlight has been active in Nova Scotia since 1996; the EHS LifeFlight team consists of highly-trained Critical Care Paramedics (CCP), Critical Care Nurses and Registered Respiratory Therapists.



### 2.2.3. Medical First Response (MFR)

Medical first responders are not health care professionals, but they can provide advanced medical first aid to their communities. They work in closely with the paramedics and in some cases they're the first response units that reach the scene. The company has about 2,000 medical first responders throughout the province. They are basically volunteers, and are an invaluable component of the system.



### 2.2.4. TeleHealth

Telehealth (811) is also part of this company which provides medical consultation to Nova Scotians and residents of Prince Edward Island for non-emergency conditions. A registered nurse, 24 hours a day, seven days a week is available to provide consultation through the phone. (Nova Scotia residents can also call 1-866-770-7763).



Tobacco Free Nova Scotia (TFNS) provides on-going counselling, program referrals across the province of Nova Scotia as well as helpful information for clients who are considering reducing or quitting the use of tobacco. To reach TFNS, one should dial 811 and ask to speak with a counsellor.

The Gambling Support Network (GSN) is available via phone and live chat 24 hours a day, seven days a week. GSN offers brief phone interventions, crisis and on-going counselling and information on available resources across the province of Nova Scotia. All counselling services are provided by clinical therapists. GSN phone number is 1-888-347-8888.

## 3. Description of the internship work

### 3.1. Introduction

EMC is one of the leading organizations in using software solutions among Nova Scotia's health care organizations, and they have been using different solutions for most of their processes for about two decades. Table 1 shows the main software solutions, their users and the key data stored in the databases of these solutions.

| System | Key data  | Users                                | Database   |
|--------|---|--------------------------------------|--|
| CAD*   | Callers data, Incident and response units' location         | Communication Officers & Dispatchers | SQL Server   |
| ProQA* | The problem of the patient(s) and management of the problem | Communication Officers               | No access to the database (individual records copied to Excel files from its AQUA) |



|              |                               |                   |                   |
|--------------|-------------------------------|-------------------|-------------------|
|              |                               |                   | reporting system) |
| ePCR*        | The Response (encounter) data | Paramedics        | SQL Server        |
| CodeStat     | Defibrillation data           | Paramedics        | Microsoft Access  |
| Fleet System | Fleet Maintenance data        | Fleet Technicians | SQL Server        |

Having many years of experience, EMC data management team has identified most of their problems. Obviously one of the problems is lack of interoperability, and since the above solutions are not logically related and they are not standardized (no semantic codes), they cannot exchange data. Generating reports and conducting research is very hard and labor-intensive. In some cases, such as reports related to cardiac arrest patients, some data from external sources, such as receiving hospitals and the medical examiner, should be added to the report, especially the outcome of the patient such as survival at discharge from the hospital. They should also provide periodic reports to some external entities, such as research centers, and every department of the company would query the databases according to their need and clean, edit and approve the data. The data management team had noticed this and defined a project to create an integrated quality database (IQDB), so that, a given record is reviewed only once (not several times by different departments), and they decided to hire a master of health informatics student to do the first phase of the project, including project plan, requirement assessment, database design and implementation as well as documentation.

### 3.2. The Project

#### 3.2.1. The Objective of the internship work

Design and develop an integrated quality database that meets the medical reporting needs of the company in 14 weeks, as well as a plan (Gantt chart for the solution).

Table 2 shows the main tasks of the project and I was responsible for the first 4 tasks.

Table 2: The main tasks of the project

| Main Tasks  | Responsibility of   |
|---|---------------------|
| 1. Requirement Assessment and Planning                | Me                  |
| 2. Database Design & development                      | Me                  |
| 3. Documentation                                      | Me                  |
| 4. Testing and Approval                               | Me and EMC IT staff |
| 5. Configuring SSIS* for periodic integration of data | EMC IT staff        |
| 6. User interface design for auditors                 | EMC IT staff        |
| 7. User interface development for auditors            | EMC IT staff        |
| 8. Testing  | EMC IT staff        |
| 9. Implementation                                     | EMC IT staff        |

\* SSIS = SQL Server Integration Services

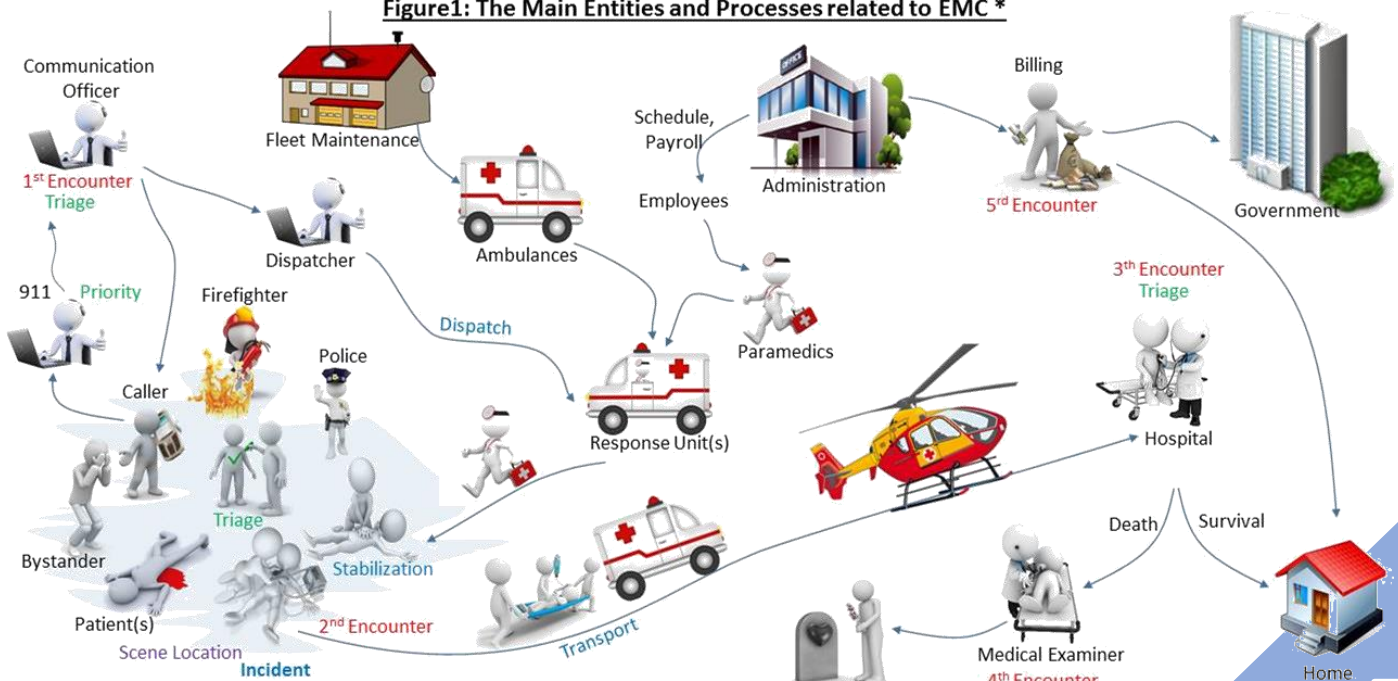
### 3.2.2. Requirement Assessment

In this phase of the project, I completed the following tasks:

- Made a Gantt chart for the whole project, and in fact table 2 is showing the main tasks of that chart. I was responsible for the 4 first tasks.
- Performed an assessment of the main processes and the data flow in the company, including meetings with the users, observation, and field visits (Figure 1)
- Identified the entities and assessed the structure and properties of the sources of data and the related applications (Table 1)
- Gathered the list of the attributes needed for the reports
- Data Analysis, including the data format, data type, possible values and references and determining the field names
- Determined the applications needed, including the integration application, the applications for the auditors, and data exchange
- Identified some of the problems and possible solutions

\* **Figure 1:** After an incident is reported by the “caller” to 911, the communication officer in 911 determines if it’s a medical “problem” and determines the priority. The call is transferred to EMC and it enters the queue on the computer screen of the communication officer, and while they’re assessing the priority, scene location and managing the patient’s problem with the help of the caller and the bystander(s), they notify the dispatcher to send the most suitable response unit(s) to the scene location. A response unit includes at least 2 paramedics and a vehicle. The paramedics’ main responsibility is finding the patient(s), stabilizing the patient(s) and transporting them to a healthcare institution such as emergency department (ED) of hospitals. The final status of the patient at discharge, survival at 30 days, and the cause of death (determined by the medical examiner) are also important data for the company. If the incident requires the presence of the police and fire fighters, they will be notified by the communication center.

**Figure1: The Main Entities and Processes related to EMC \***



### **3.2.3. Database Design and Development**

- Categorized the data
- Identified the primary keys and foreign keys
- Designed the entity-relationship diagram and created the tables
- Reviewing the terms and categories for the tables and the attributes with the data analysts of the company
- Created the reference tables for the values of the attributes where applicable
- Performed the data mapping with the EMC system analyst

### **3.2.4. Documentation**

Documentation was done throughout the project and included:

- The data needed for reporting (the attributes)
- Best source of data (some data were repeated in different databases)
- How to get the data from internal sources (data mapping)
- How the categorization was done
- Where to find a given data in the new database
- How the reference values for each attribute was determined and what they are

### **3.2.5. Testing and Approval**

In this phase we integrated some data and tested the database for the followings:

- Existence tests for database schema elements (tables, procedures, ...)
- Referential integrity (RI)
- Default values for a column
- Data invariants for a single column
- Data invariants involving several columns

## **4. Discussion of how the internship work relates to health informatics**

As it was mentioned in the internship work section, the project was related to most of the courses in the health informatics program, including

- Project management
- Health information flow and use
- Flow and standards
- Systems and issues
- Networks and Web

The project management course helped me develop a Gantt chart and have a plan for the project. The health information flow and use, and the flow and standards courses made it possible for me to develop a storyboard, recognize the processes, assess the work flow, and deal with the indicators. The systems and issues course helped me with the data flow and systems boundaries. Finally, the networks and web course helped me identify the entities, categorize the data and the tables, build a logical relationship between the tables and design the database. Querying the sources of data helped me in determining the data types and the values for each attribute and creating the reference tables. Finally, my knowledge and experience in medicine and emergency management helped me in categorizing the data, identifying the problems and proposing solutions.

## **5. Critical analysis of the problems in EMC that merits a health informatics solution**

### **5.1. Lack of Interoperability (The Main Problem)**

The software solutions that are used in the company are neither logically related nor standard; as a result, they cannot exchange data. Reporting and conducting research requires a combination of automatic integration of data from some sources and manual data entry from other sources, as well as manual editing and approval of the integrated data which is labor-intensive.

### **5.2. The current solutions do not limit User Errors**

There are many fields in the application where user errors could be limited by the solution. Users have to type in the textboxes in the applications for many fields. This has significantly affected the validity of the data stored. For example, there are about 50,000 distinct “Working Diagnoses” stored in the database. The same problem exists for many other fields such as the name of the city or province.

One of these fields is for health card number, which is currently manually entered. I wrote a query to assess the validity of the health card numbers stored in the database (for retrospective assessment). It was also proposed to use card scanners for reading the data from health cards and the company is planning to purchase tablets with card scanners for the response units.

### **5.3. The ePCR solution is not user-friendly**

The ePCR (electronic patient care record) used by paramedics is a very complex solution, and sometimes it is very hard for the paramedics to find the field they want to enter a given data, as a result paramedics tend to enter the data in comments when they cannot find the field for that data.

### **5.4. Problems with Transferring data from the Defibrillation devices**

The defibrillation devices produce data regarding vital signs, electrocardiograms (ECGs) and the shocks given to the patient. Transferring the data from the device requires internet connection and since there’s no logical relationship between its database and other databases in the system, the patient id is manually entered and it’s sometimes incorrect.

## **6. Suggestions**

**6.1. Capturing Patient personal data:** using card scanners for reading the data from health cards can limit manual data entry errors and save time.

**6.2. Standardization of data:** The reference tables used in the current solutions are not standardized and many fields are filled as free text. The data elements in these tables should be standardized so that the data become machine-processable.

**6.3. Interoperability:** using semantic codes for the terms used in the systems, can help with exchanging data with external entities and reporting.

**6.4. User-friendliness:** The solutions used by paramedics should be as simple and concise as possible. Paramedics should be able to complete the report for emergency departments as fast as possible.

## **7. Conclusion**

The future solutions should see EHS companies as one system and extend the boundaries of their systems or be able to exchange data automatically within the organization. An effective system enables the company to schedule shifts according to availability of the paramedics (the administration system) and the ambulances (the fleet maintenance system), and provide a logical relationship between the computer-assisted dispatch system (CAD) and the electronic patient care record (ePCR), while facilitating transfer of data from defibrillation devices and other subsystems. The current systems are not standard and cannot exchange data with external entities. Integrating the existing solutions as well as using standard semantic codes for data exchange is one of the options. The software companies should try to limit user errors by creating reference tables from historical data or scientific resources, and by using other methods such as card scanners. Some of the current software solutions are not user-friendly and the companies should try to customize their solutions according to the type of the service.

## Appendix 1

### Complete Project Plan (subtasks of Tasks 4 are not shown)

| Task Name   | Duration        | Start         | Finish            | Predecessors | Resource Names             |
|---|-----------------|---------------|-------------------|--------------|----------------------------|
| <b>IQDB Project Plan</b>  | <b>130 days</b> | <b>May 15</b> | <b>Oct 4</b>      |              |                            |
| <b>1. Requirement Assessment</b>  | <b>48 days</b>  | <b>May 15</b> | <b>Wed Jul 19</b> |              |                            |
| 1.1. Planning & High Level Assessment                                     | 8 days          | May 15        | May 24            |              | Arman                      |
| 1.2. Assessing Data Requirements  | 25 days         | May 25        | Jun 28            | 2            | Ehsan,Arman,Judah,Mary     |
| 1.3. Assessing the workflow   | 7 days          | May 29        | Jul 4             | 3            | Mary,Arman,Ehsan,Judah,Del |
| 1.4. Assessing data sources and formats                                   | 5 days          | Jun 7         | Jul 5             | 4            | Arman,Ehsan,Del            |
| 1.5. Assessing Data Mapping Between Required Fields and Available Sources | 10 days         | Jul 5         | Jul 19            | 5,3          | Arman,Ehsan                |
| 1.6. Data Access requirements   | 1 day           | Jun 14        | Jul 5             | 5            | Arman,Ehsan,Judah,Mary     |
| 1.7. Assessing the data flow  | 7 days          | Jun 15        | Jul 7             | 7            | Del,Arman,Ehsan,Judah,Mary |
| 1.8. Technological requirements   | 1 day           | Jun 26        | Jun 26            | 8            | Arman,Ehsan                |
| 1.9. Requirement Specification document                                   | 6 days          | Jun 27        | Jul 4             | 9            | Arman                      |
| <b>2. Database Design and Development</b>                                 | <b>58 days</b>  | <b>Jul 5</b>  | <b>Sep 1</b>      |              |                            |
| 2.1. Find solutions to relate the sources                                 | 5 days          | Jul 5         | Jul 11            | 10           | Arman,Del,Ehsan            |
| 2.2. Deigning the database  | 14 days         | Jul 12        | Jul 31            | 12           | Arman                      |
| 2.3. ETL Implementation   | 17 days         | Jul 31        | Aug 17            | 14           | Arman,Ehsan                |
| 2.4. Documentation  | 7 days          | Aug 3         | Aug 17            | 16           | Arman                      |
| 2.5. Testing Database and Data Import                                     | 14 days         | Aug 18        | Sep 1             | 15           | Arman,Ehsan                |
| <b>3. Application Design and Development</b>                              | <b>75 days</b>  | <b>Sep1</b>   | <b>Nov 15</b>     |              |                            |
| <b>4. Project Complete</b>  | <b>0 day</b>    |               |                   | 25           |                            |
| <b>5. Maintenance</b>   | ...             |               |                   | 26           |                            |

## Appendix 2

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# Integrated Quality Database (IQDB)

## Reference Document

By Arman Izadi

August 2017, Version 1.3

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### Outline

1. Introduction
    - 1.1. General Rules in Designing the Database
    - 1.2. Main Tables
  2. The Entities, Tables and the Attributes
    - 2.1. The First Encounter
    - 2.2. The Second Encounter
    - 2.3. Patient Follow Up (External Encounters)
- 

### 1. Introduction

The Integrated Quality Database (IQDB) was built to reduce the cost and time spent on reviewing and editing patient records for reporting purposes. It was designed mainly for cardiac arrest cases but it has the potential to be used for other conditions. The database is for reporting purposes and does not include all the attributes of a given entity, but the selected ones that are essential for reporting.

The database has about 70 tables and covers three categories of encounters: the first encounter is between the communication center and the caller, the second encounter is between the paramedics and the patient, and the external encounters between the patient and other health care providers. Before talking about the individual entities, tables and attributes, there are some general rules that I tried to follow while categorizing the data elements.

## 1.1. General Rules in Designing the Database:

- **The Name Format:**
  - The first letter of all the words used in tables or attributes names is capitalized.
  - If there are several words in the name of the tables, they are separated by underscores, but they are not separated in the names of the attributes, for instance, “Call\_Takers” is the name of a table, but “CallTakerId” is the name of an attribute.
  - All the keys (Primary or Foreign keys) have an “Id” at the end of their names except the “MIN” (main incident number).
- **Reference tables:** Reference tables start with “RT” such as “RT\_Impressions” which includes all of the possible impressions that can be used in the related data table which is called “Patient\_Impression”. The options in the reference tables can be edited, or added.
- **Data Tables:** Any table that does not start with “RT” is a table that contains data recorded by the users. Most of the clinical data can be found in the tables that start with “Patient”
- **RT\_Yes\_No\_Unknown**

In this reference table we have 3 values Unknown= -1, No= 0, and Yes= 1. And the Id number starts from -1, as a result, the id number and the value of these options are the same. Therefore, when querying you may not need to “join” the tables with this reference table, since you know Unknown= -1, No= 0, and Yes= 1. In many tables these values may be used for the attributes.
- **Editors and Auditors**

All the reference tables have an EditorId column to show the person who has edited these tables and all the data tables have an AuditorId column to show who has corrected the data in a given record in that table. Copying the data from the source databases will not affect these fields.
- **Dates**

Most tables have a DateCreated and DateModified column showing the date that the record has been copied to the database and the date that it has been modified by the auditors or editors. These dates are not copied from the source databases and we have **only two dates** that are copied from the source databases: CallDate (for the first encounter) and ResponseDate (for the second encounter).
- **Times**

Almost all the “times” are gathered in the “times” table, such as “TimeDispatched”, “TimeArrivedAtScene”, and “TimeSceneDeparted”, and all of their names start with “Time”.
- **Modes**

We have two types of modes: ResponseMode and TransportMode and both are shown in this table and each has their own reference table.
- **Addresses**

All the addresses are in the “Addresses” Tables
- **Phones**

All the phones are in the phones table except the caller’s phone which is in the Call\_Information Table



## 1.2. Main Tables

There are 3 main “Encounters” between the patient and the health care providers, these encounters are called “Call\_Information”, “Response” and “Patient\_Follow\_Up” in this database. The first two encounters relate all the tables in the database and include the internal data, but the third main table includes the data from the external sources.

- ✓ **Call\_Information:** is the table for the first encounter where callers and call-takers encounter. The primary key is “MIN” (Main incident number) and “CallerId” and CallTakerId” are the main foreign keys
- ✓ **Response:** is the table that links the “Call\_Information” table to patient information and the activities performed by the paramedics (response). The primary key is “ResponseId” and the main foreign key is “MIN”. Since the original databases are not patient-centric systems, it was not possible to create a second encounter table containing the PatientId and the ResponseUnitId as the foreign keys.
- ✓ **Patient\_Follow\_Up:** shows data from other encounters related to external entities. It is the main table for data from external sources such as the hospitals and the medical examiner (ME).

## 2. The Tables and the Attributes

The attributes represent characteristics of each entity in the database, and in this section the individual tables and attributes are discussed:

### 2.1. The First Encounter:

In the first encounter we have the following entities:

- Caller
- Call\_Taker
- Problem

The related tables are (Primary Keys are shown in red, and Foreign Keys in blue)

#### 2.1.1. Callers Table

With the following attributes

- ✓ **CallerId** (Primary Key)
- ✓ FName
- ✓ MName
- ✓ LName
- ✓ Phone
- ✓ DateOfCall
- ✓ DateCreated
- ✓ DateModified

#### 2.1.2. Call\_Takers Table

Call\_Takers have an employeId and the table has the following attributes

- ✓ **CallTakerId** (Primary Key)
- ✓ **EmployeeId**
- ✓ **DateCreated**
- ✓ **DateModified**

### 2.1.3. Call\_Information Table

Where Callers and Call\_Takers encounter and the table has the following attributes

- ✓ **MIN** (Primary Key)
- ✓ **CallerId** (Foreign Key from Callers Table)
- ✓ **CallTakerId** (Foreign Key from Call\_Takers Table)
- ✓ **IncidentAddressId** (address of the incident, Foreign Key from Addresses Table)
- ✓ **Determinant**
- ✓ **DateCreated**
- ✓ **DateModified**

The table has no column for address since the actual address of the incident is the address in the “Response” table

### 2.1.2. Patient Tables in the First Encounter

#### 2.1.2.1. Patient\_Problem Table

Shows the problem of the patient stated by the caller. The table has the following attributes

- ✓ **PatientProblemId** (Primary Key)
- ✓ **MIN** (Foreign Key from Call\_Information Table)
- ✓ **ProblemId** (Foreign Key from the reference table for problems, “RT\_Problems”)
- ✓ **DateCreated**
- ✓ **DateModified**

#### 2.1.2.2. Patient\_Problem\_Management Table

Shows the management of the problem by the call taker, using ProQA. The table has the following attributes

- ✓ **ProblemManagementId** (Primary Key)
- ✓ **MIN** (Foreign Key from Call\_Information Table)
- ✓ **ManagementId** (Foreign Key from the reference table for management, “RT\_Managements”)
- ✓ **DateCreated**
- ✓ **DateModified**

## 2.2. The Second Encounter

In the response we have the following entities

- Patient
- Crew (Paramedics, ...)
- Ambulances
- Witnesses
- Location (of the incident)
- Chief complaint (the patients main symptom)
- Findings (includes symptoms, signs, and any other clinical findings)

- Impression (The Condition)
- Etiologies (the cause of the condition)
- Interventions (any kind of medical or surgical treatment, intervention or management by the paramedics)
- Outcomes
- Receiving Institutions

The related tables are (Primary Keys are shown in red, and Foreign Keys in blue)

### 2.2.1. Response Table

Since we don't have a unique and real "PatientId" in ePCR and the "PatientId" in ePCR is in fact the "ResponseId", and since there is no actual "encounter" table between the patient and the response units, in the integrated quality database (IQDB) we have a response table with ResponseID as the primary key, and all the entities that are related to this table have the ResponseID as a foreign key in their table, such as the Patient\_Info, Response\_Crew\_Ambulance, and Patient\_Interventions tables. The response table has the following attributes and is related to the Call\_Information Table with the "MIN".

- ✓ **ResponseId** (Primary Key, equal to PatientID in ePCR)
- ✓ **MIN** (Foreign Key from the 1<sup>st</sup> encounter, "Call\_Information" Table)
- ✓ ResponseDate (Date and time of the response)
- ✓ **ResponseAddressId** (Foreign key from Addresses Table)
- ✓ **LocationTypeId** (Foreign key from RT\_Location\_Types Table)
- ✓ DateCreated
- ✓ DateModified

### 2.2.2. Patient\_Info Table

With the following attributes

- ✓ **PatientId** (Primary Key)
- ✓ **ResponseId** (Foreign key from the Response table)
- ✓ FName
- ✓ MName
- ✓ LName
- ✓ DOB (date of birth)
- ✓ Age
- ✓ **AgeUnitId** (Foreign key from the RT\_Age\_Units table)
- ✓ **Estimated** (if age is estimated or not, Yes=1 or No=0 from the RT\_Yes\_No\_Unknown table)
- ✓ **AgeCategoryId** (Foreign key from the RT\_Age\_Categories table, categories provided by CanROC)
- ✓ **GenderId** (Foreign key from the RT\_Genders table)
- ✓ **HealthCardTypeId** (Foreign key from the RT\_Health\_Card\_Types table)

- ✓ HealthCardNumber
- ✓ IssuingProvinceId (Foreign key from the RT\_Provinces table)
- ✓ AddressId (Foreign key from the Address table, Patient's mailing address which can be different from the incident location address)
- ✓ PhoneId (Patient's Phone number which can be different from the caller's phone)
- ✓ TissueDonationId (if the patient had been willing to donate tissue, Foreign key from the RT\_Yes\_No\_Unknown table)
- ✓ DNRId (if the patient had requested "Do Not Resuscitate" , Foreign key from the RT\_Yes\_No\_Unknown table)
- ✓ DateCreated
- ✓ DateModified

### 2.2.3. Response\_Crew\_Ambulance Table

Shows the Crew and the ambulances that were part of the response. With the following attributes

- ✓ ResponseCrewAmbulanceId (Primary Key)
- ✓ ResponseId (Foreign key from the Response table)
- ✓ CrewId (Foreign key from the Crew table)
- ✓ CrewRegionId (Foreign key from the RT\_Crew\_Region reference table)
- ✓ AmbulanceId (Foreign key from the Ambulances table)
- ✓ DateCreated
- ✓ DateModified

### 2.2.4. Patient Tables in the Second Encounter

**2.2.4.1. Patient\_Chief\_Complaints Table** (in ePCR a patient can have primary, and secondary chief complaints and OB complaint. The table includes the following attributes:

- ✓ PatientChiefComplaintId (Primary Key)
- ✓ ResponseId (Foreign key from the Response table)
- ✓ ChiefComplaintId (Foreign key from the RT\_Chief\_Complaints table)
- ✓ TypeId (Foreign key from RT\_Chief\_Complaint\_And\_Impression\_Types table)
- ✓ DateCreated
- ✓ DateModified

**2.2.4.2. Patient\_Impressions Table** (in ePCR a patient can have primary and secondary Impressions, TypeId is from RT\_Chief\_Complaint\_And\_Impression\_Types table) The table includes the following attributes:

- ✓ PatientImpressionId (Primary Key)
- ✓ ResponseId (Foreign key from the Response table)
- ✓ ImpressionId (Foreign key from the RT\_Impressions table)
- ✓ TypeId (Foreign key from RT\_Chief\_Complaint\_And\_Impression\_Types table)
- ✓ DateCreated
- ✓ DateModified

**2.2.4.3. Patient\_Findings Table** (include any symptom, sign or risk factor that was found by the paramedic. And the FindingId is from RT\_Finding table). The table includes the following attributes:

- ✓ PatientFindingId (Primary Key)
- ✓ ResponseId (Foreign key from the Response table)
- ✓ FindingsId (Foreign key from the RT\_Findings table)
- ✓ DateCreated
- ✓ DateModified

**2.2.4.4. Patient\_Etiologies Table** (shows the cause of the patient's condition and the EtiologyId is from the RT\_etiologies Table). The table includes the following attributes:

- ✓ PatientEtiologyId (Primary Key)
- ✓ ResponseId (Foreign key from the Response table)
- ✓ EtiologyId (Foreign key from the RT\_Etiologies table)
- ✓ DateCreated
- ✓ DateModified

**2.2.4.5. Patient\_Interventions Table** (shows the medical treatments, and surgical interventions, or procedures that were done for the patient and the InterventionId is from the RT\_Interventions Table). The table includes the following attributes:

- ✓ PatientInterventionId (Primary Key)
- ✓ ResponseId (Foreign key from response table)
- ✓ InterventionId (Foreign key from RT\_Interventions table)
- ✓ DateCreated
- ✓ DateModified

Interventions have 3 related tables: CPR and Defibrillation are two interventions that have their own metrics; as a result, we have CPR\_Metrics and Defib\_Metrics tables. And some interventions may be attempted several times with different results.

#### 2.2.4.5.1. CPR\_Metrics Table

- ✓ CPRMetricsId (Primary Key)
- ✓ ResponseId (Foreign key from response table)
- ✓ Minute
- ✓ StartTime
- ✓ Rate
- ✓ Depth
- ✓ Fraction
- ✓ ETO2
- ✓ SecondsWithoutData
- ✓ StopTime
- ✓ ReasonForPauseId (Foreign key from RT\_Reasons table)
- ✓ ReasonCPRDiscontinuedId (Foreign key from RT\_Reasons table)
- ✓ DateCreated
- ✓ DateModified

#### 2.2.4.5.2. Defib\_Metrics

- ✓ DefibMetricId (Primary Key)
- ✓ ResponseId (Foreign key from response table)
- ✓ ShockNo

- ✓ Jouls
- ✓ ParamedicDefibEffectId (Foreign key from RT\_Paramedic\_Defib\_Effects table)
- ✓ DateCreated
- ✓ DateModified

**2.2.4.5.3. Patient\_Interventions\_Attempts Table** (Records the intervention, Attempt number and if the Attempt was successful). It can be recorded for any intervention such as intubation. The table includes the following attributes:

- ✓ PatientInterventionAttepmId (Primary Key)
- ✓ ResponseId (Foreign key from response table)
- ✓ InterventionId (Foreign key from RT\_Interventions table)
- ✓ AttemptNumber (is a number)
- ✓ Successful (Yes =1, No = 0, Unknown = -1)
- ✓ DateCreated
- ✓ DateModified

**2.2.4.6. Patient\_Outcome Table** (shows any type of outcome related to “our” response including the response outcome, and clinical outcome of the patient). The attributes include:

- ✓ PatientOutcomeId (Primary Key)
- ✓ ResponseId (Foreign key from response table)
- ✓ ResponseOutcomeId (Foreign key from RT\_Response\_Outccome table)
- ✓ FinalStatusWithEMSID (Foreign key from RT\_Final\_Status\_With\_EMS table)
- ✓ MEDiagnosisId (foreign key from RT\_ME\_Diagnosis table)
- ✓ DateCreated
- ✓ DateModified

**2.2.4.7. Patient\_Comments Table**

There are several columns in ePCR with similar titles such as “comments”, “UserComments”, and “Additional Data”, and the paramedics sometimes enter important data in these fields, such as impression or clinical outcome. Therefore, these fields should be queried and stored in the IQDB, to let the auditors review them. The attributes in this table are:

- ✓ PatientCommentId (Primary Key)
- ✓ ResponseId (Foreign key from response table)
- ✓ Comment
- ✓ DateCreated
- ✓ DateModified

**2.2.5. Cardiac\_Arrest\_Specific Table**

The attributes or data elements that were specific to cardiac arrest and could not be included in other tables can be found in this table, such as “ArrestArrivalRelationship”. In the future when other important conditions, such as trauma, are added, we may have a “Trauma\_Specific” table for such data elements. The table includes the following attributes:

- ✓ **CardiacArrestSpecificId** (Primary Key)
- ✓ **ResponseId** (Foreign key from response table)
- ✓ **ArrestArrivalRelationshipId** (Foreign key from RT\_Arrest\_Arrival\_Relationship table)
- ✓ **ArrestWitnessedId** (Foreign key from RT\_Witnesses table)
- ✓ **PriorResuscitationAttempts** (Yes= 1, NO= 0, Unknown= -1)
- ✓ **CardiacRythemOnArrival** (Foreign key from RT\_Cardiac\_Rythems table)
- ✓ **FirstMonitoredRythem** (Foreign key from RT\_Cardiac\_Rythems table)
- ✓ **ROSC** (Yes= 1, NO= 0, Unknown= -1)
- ✓ **DateCreated**
- ✓ **DateModified**

### 2.2.6. Receiving\_Institution Table

Includes the following attributes

- ✓ **ReceivingInstitutionId** (Primary Key)
- ✓ **ResponseId** (Foreign key from response table)
- ✓ **InstitutionId** (Foreign key from RT\_Institutions table)
- ✓ **DateCreated**
- ✓ **DateModified**

## 3. Patient Follow Up (External Encounters)

In addition to the patient, we have two sources for patient follow up data, which are:

- The receiving institution (usually a hospital)
- The Medical Examiner (ME)

I created one table for the follow up called “Patient\_Follow\_Up”

### 3.1. Patient\_Follow\_Up Table

The table has the following attributes:

- ✓ **PatientFollowUpId** (Primary Key)
- ✓ **ResponseId** (Foreign key from response table)
- ✓ **AnyInHospitalROSC** (Yes= 1, No= 0, Unknown= -1)
- ✓ **ReperfusionAttemptedinHospital** (Yes= 1, No= 0, Unknown= -1)
- ✓ **TimeOfTargetedTemperatureManagementId** (Foreign key from RT\_Time\_Of\_Targeted\_Temperature\_Management table)
- ✓ **FinalStatusWithEDId** (Foreign key from RT\_Final\_Status\_With\_ED table)
- ✓ **SurvivedtoDischarge** (Yes= 1, No= 0, Unknown= -1)
- ✓ **SurvivalAt30Days** (Yes= 1, No= 0, Unknown= -1)
- ✓ **CPCScoreAtDischargeId** (Foreign key from RT\_CPC\_Score table)\*
- ✓ **mRSScoreAtDischargeId** (Foreign key from RT\_mRS\_Score table)\*
- ✓ **MEDiagnosisId** (Foreign key from RT\_ME\_Diagnosis table)
- ✓ **DateCreated**
- ✓ **DateModified**

\* CPC and mRS scores show patients’ neurological status at discharge from the hospital and only one of these scores are required by CanROC.