Final Technical and Orientation Manual

Mega Database

Paramedic Chiefs of Canada in partnership with the Paramedic Association of Canada and Interdev Technologies

2014

Table of Contents

Background

Research in Emergency Medical Service (EMS) has always been very challenging given limited access to paper based data, confidentiality and consent issues as well as the relative infrequency of the really catastrophic events within an individual EMS service. Additionally, smaller EMS services simply do not have the call volume to conduct research or to generate the numbers to all for significant data to be evaluated.

Electronic Patient Care Record systems (ePCR) have been emerging nationally over the last decade. There now exists a critical mass of EMS data that can be exploited if it could be easily accessed. The barrier to accessing this at present is that Emergency Medical Services in Canada are provided by a variety of organizations, ranging from volunteer first responders, private-for-profit providers, Fire Departments, hospitals, local and provincial/territorial government ambulance services. Each may operate their own ePCR system. In addition there are multiple vendors providing ePCR systems resulting in variations in the data structure of the ePCR databases containing the sought-after data.

This project resolved the data access problems by creating a large nationally based EMS Mega Database (MegaDB) for the benefit of all EMS providers and researchers. This project was initially limited to the Paramedic providers in the Province of Ontario but is intended to increase in scope across Canada. This initial database will continue to grow as information is added and it is planned to later be expanded by linking with ePCR systems in other provinces to establish a National EMS database with a minimum dataset.

Paramedic services now have direct access to this large volume of information, which will allow for evidence based practice to inform policy and operational strategies. This will permit increased operational awareness enhancing strategic planning and future operational considerations. With the aging population, shifting demographics, regionalization of healthcare and the restructuring of hospitals, EMS must anticipate the impact all these will have on their future services.

Technical Achievements

The Mega database was designed to hold all EMS data for Canada for many historical years and thus required an appropriately sized server infrastructure to support the storage and querying of the data. As part of the proposal process we agreed on an infrastructure that consisted of 2 large database servers and a common SAN to support the data between the two servers. This infrastructure was setup and consists of the following equipment:

- Dual 8 core processor servers at 3.33Ghz (Total 16 cores).
- 196 Gig Ram.
- 7 TB hard drive space (RAID configuration, actually 12Tb of hard drives).
- All data maintenance Routines, backup procedures, and security setup.
- Web Service portal created to accept data via the web from participating services.
- Interface documentation and data definitions issued to the EMSCC for distribution.

Currently, there are over a million calls that have been entered into the Mega Database consisting of over 6.5 million data points.

Data Transmission Procedure

Interdev created and has made publically available a web services interface which allows any outside EMS agency to submit data for inclusion in the Mega Database.

The Web Service can be located at the below address:

Web Service: **http://192.168.250.158:8093/services/Mirth**
WSDL:**http:// 192.168.250.158:8093/services/Mirth?wsdl**
(Note that these are internal IP addresses. Connection details for each service is created individually and can include but are not limited to VPN or HTTPS connections.)

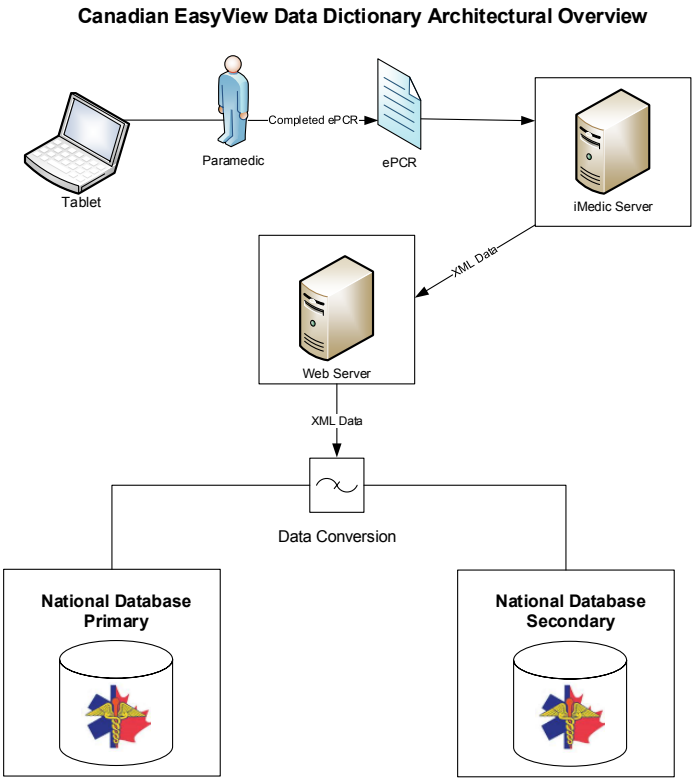
The Web serviceuses the Mirth Connect environment to provide all interface support, security, and logging. More information on Mirth Connect and its capabilities can be found at:

http://www.mirthcorp.com/products/mirth-connect

The process to send data to the Mega Database is outlined below:

1. Contact Interdev to obtain the following.-
    a. 5 digit iMedicID that is used for generating unique IDs for XML.
    b. Set up security access used for accessing the Secured Web service.
2. Generate XML
    a. Create logic for generating Unique IDs for XML. Refer to section: Generate Unique IDS.
    b. Refer to section:XML Mandatory Elements to verify requirements.
    c. Refer to section: DBO Tables for identifying the data element type and other information useful in generating the XML. Please note that all the elements in the DBO Tables section do not appear in the XML element.
    d. Generate XML of Patient Care Record based on the sample XML found in this document (Refer to Appendix A – Sample XML for ACRData).
3. Locate the Web Service URL found in section: Available URL for Web Service.
4. Send in the Request Object to the web Service. Refer to Section: Sample Request Object for Calling Web Service .
5. Check the response object to confirm if the message was added successfully. Unsuccessful responses will return with Error Codes and Error Descriptions Refer to section: Sample Response Object from Web Service and also section: Error Code List.

Data Flow Process



Process

EMS calls performed by paramedics are entered into an electronic charting program for legal, QA, and reporting purposes. This information, whether gathered by mobile tablets or web enabled computers, is collected at a central location for the service or agency (iMedic Server or ePCR server). The data is transferred to the web server which hosts the web service data gathering portal. This portal accepts the data, converts it (as needed) and inserts it into both copies of the Mega Database. Each copy of the Mega database has its own physical SQL server to run queries on.

Dataset

The DataSet consists of several tables that each represents a different aspect of the ambulance call report (Patient Care Report, PCR). The tables are:

DataSet High Level Elements			
Parent Element	**Represents**	**Note**	**# of Data Points**
ACRData	All primary data that exists only once per call	Master table for all queries. One record per patient care session.	203
ACRCrewGrid	Paramedic Crew assigned to the call	Can be 1 or many and may include non-paramedic crew	7

		members.	
ACRFluidBalanceGrid	Total Fluid in and Fluid out from a patient during the call	This is important in the fluid management of the patient. The type of fluid generally indicates the direction.	6
ACRProceduresGrid	Any time stamped event important to the chronology of the call		6
ACRProcedureAnswersGrid	Any additional datapoints for each procedure. Each datapoint is a separate row		8*
ACRTime	All times for all tables	All time fields broken down into date, time, and datatime	6

*Note: Each row represents a distinct data point depending on the Question being asked per procedure. Actual number of data points is in the 100s.

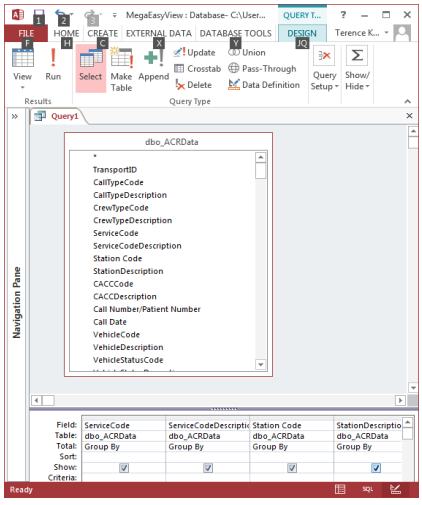
All data from any ePCR vendor is amalgamated into this data structure. The received data is validated for data type conformation before the data is amalgamated. Any record that has malformed data is rejected and an appropriate error message returned.

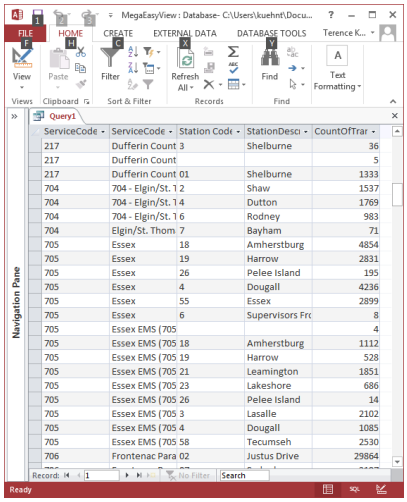
Queries

An almost unlimited number of queries can be run against the database as all key information from the delivery of Ambulance Services is available. Some sample quires are shown below:

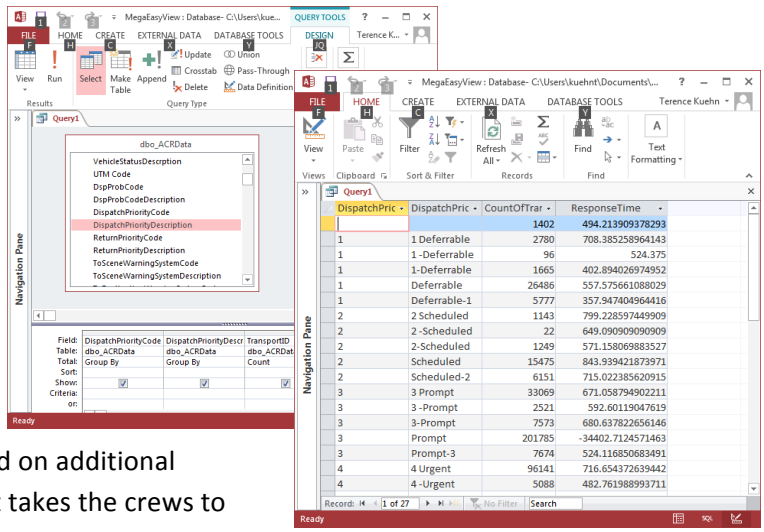
Simple Call counts

Simple queries like how many emergency calls a given service or station can easily be formed by dragging data from the table and setting query parameters to return the values desired. In the sample below a query of how many calls each service and station perform is shown. This query can then be further refined to include date ranges, response time ranges, type of calls, etc.



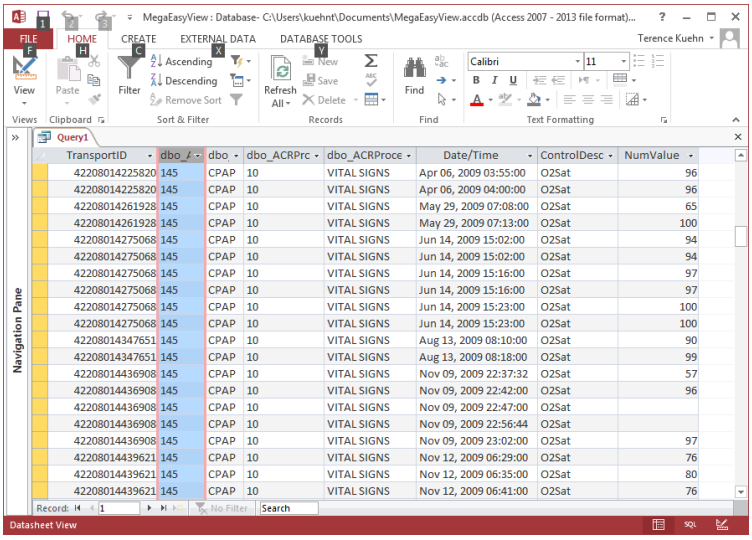


Operational Queries



Through this data new National performance metrics can be generated. This will allow paramedicServices the ability to compare their services performance responses to other services of similar size and geography. Queries can be created easily that calculates performance, in this case response time, and compares them based on additional factors. Response time is the time that it takes the crews to get to the scene of the call and it is calculated from the time they are notified by dispatch until the time they arrive on scene.

Clinical Queries



Paramedic Services are interested in looking at ways to improve the care they give their patients. By looking at outcomes from interventions they can refine procedures and alter measure changes based on patient population. All services deliver patient care differently and comparisons of these alternatives can be an effective way to run an improvement process. The example below shows all calls that have a CPAP (Continuous Positive Airway Pressure) device applied to a patient in order to help improve the oxygen saturation of the patients' blood. Included in the results are all the blood oxygenation results (O2Sat) as recorded by the defibrillator/monitors. Services can now see the effectiveness of using this device and can evaluate under what situations they should be used.

Operational Recovery Methods

All data received by the Mega Database is replicated between the two (2) servers for redundancy and performance. These two servers provide backups to each other and can be re-synchronized in the event of a database loss or corruption. In addition to this cross backup strategy, the databases are backed up using SQL Server Backup on a weekly basis. One of these backups is sent to our secondary hosting site at PIER1 and can be retrieved from this site and restored if needed.

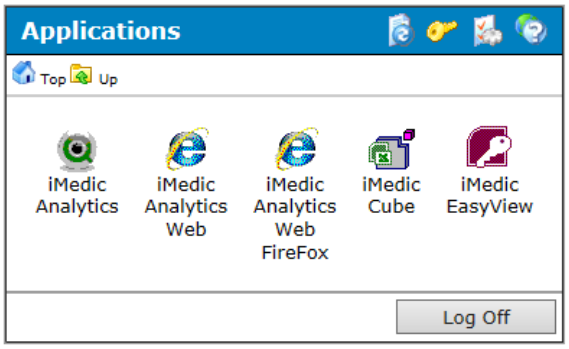
The final level of backup exists from the source data itself. In the event that both servers and the backups are unusable, the information can be re-transmitted from the source EMS server to rebuild the mega database.

In the event of a failure on any one data server, the other server can act as a fully functional query and data gathering server. These servers have their images backed up at regular intervals so that the entire server can be restored if needed.

Reports

Accessing the Database

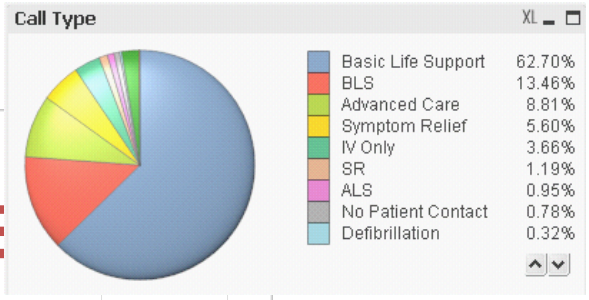
Subscribing Services can access all the information in the Mega Database by logging into the Citrix Server portal. This portal enables all the security and authentication, as well as provided the communication encryption layer (via HTTPS using SSL). Once on Citrix, a copy of MS Access, Cube, and Analytics is available to use with all the mega data accessible. From here the user can query whateverthey want.

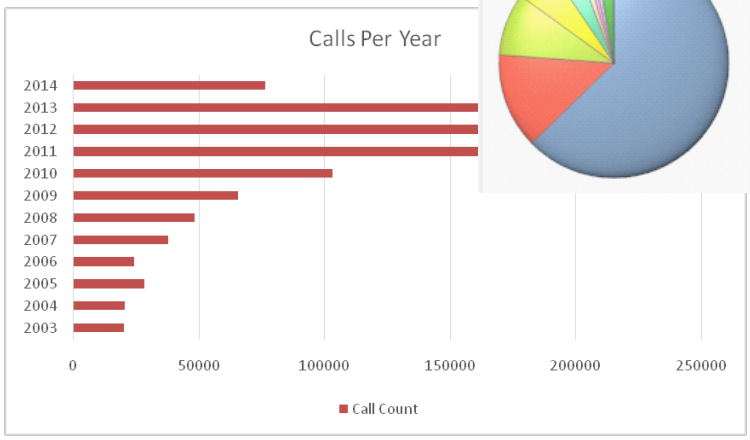


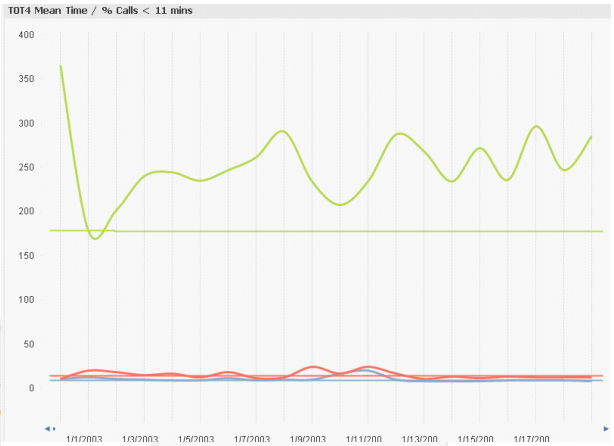
Types of Reports

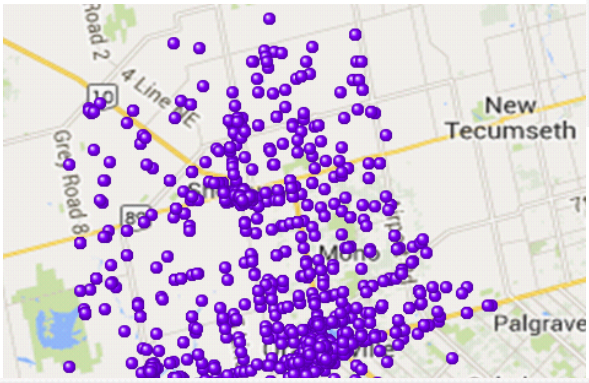
Charts

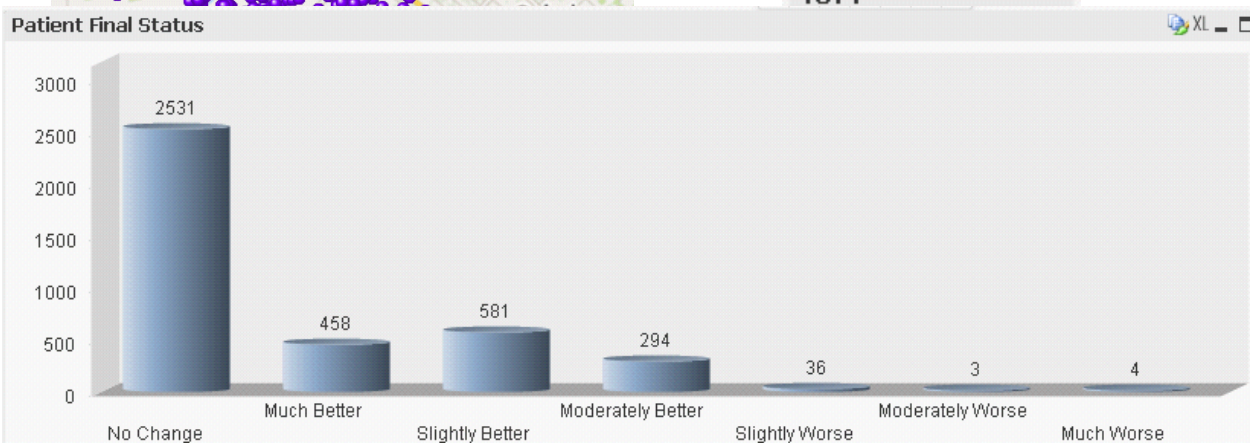
There are an endless number of charts and permutation of charts that can be added to any of the data analysis tools supported by the Mega Database. Some samples are shown below:





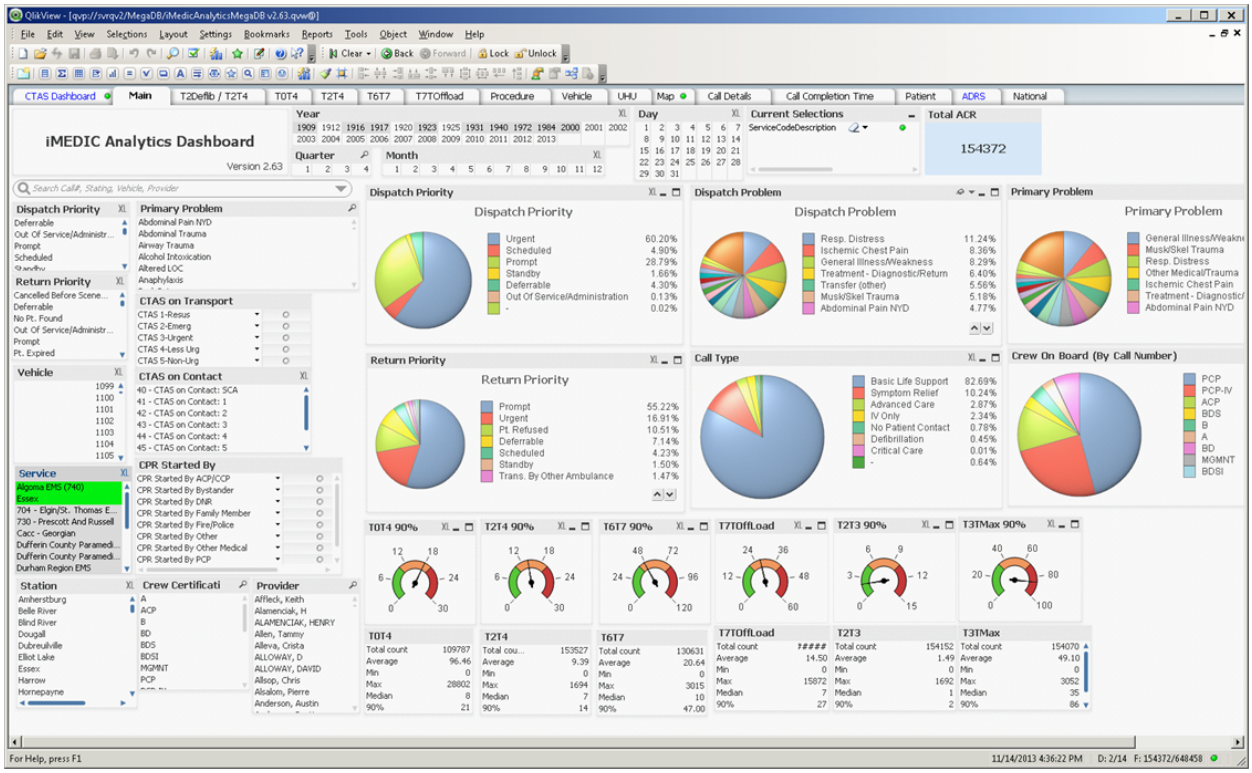






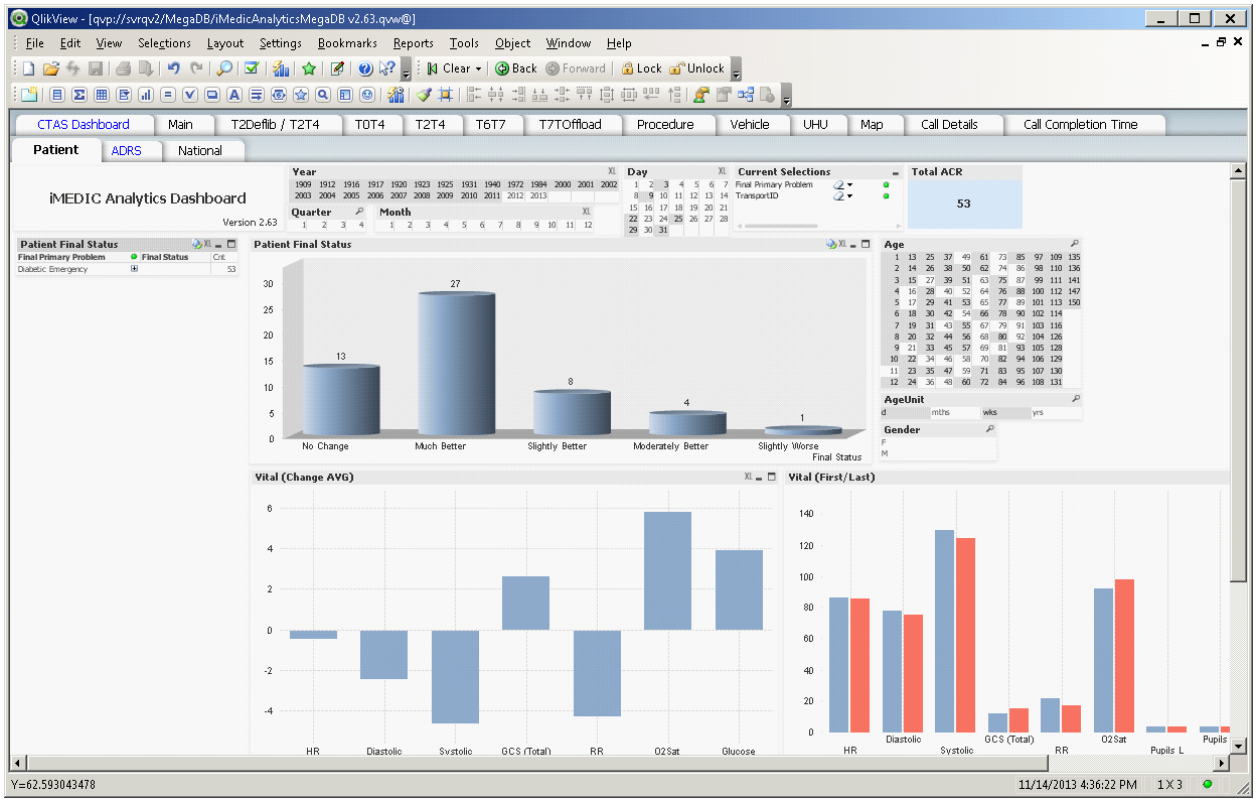
Operational Metrics

A typical dashboard can be shown to highlight operational metrics such as dispatch priority and compare that to return priority in an effort to examine which calls have higher patient acuity. A sample of this is shown below. As different tabs are selected the pie graphs instantly are updated so immediate feedback is given.



Patient Care Metrics

Clinical interventions can be easy to analyze by simply selecting the intervention and looking at the resultant outcomes as recorded in vital signs data. This vital signs data is collected primarily from the Cardiac Monitor/Defibrillators that the paramedics carry. The example below shows the responses to diabetic emergencies and the outcomes both in the status of the patient and Blood glucose levels.



Video Re-Play

The Mega Database does have the capacity to accept cardiac waveforms recorded on the call. The challenge is that most paramedic services currently input the patients name into the cardiac document and is part of the file so cannot be removed. As part of the Mega database project the agreement with services was that no patient identifiers would be included. Should this change, the future capacity is there to store the information.

Conclusions

This project allowed for the first integration of electronic patient care records and has established a platform for future initiatives. There is capacity within the existing system to allow for expansion and increased performance metrics generation for paramedic services. This new interface will allow data to be pooled and create opportunities that did not exist previously.

As national standards and benchmarks are established the evidence based dataset will help inform future direction. Performance metrics can now be created and observed to measure trends, capacity, and patient care outcomes. This will help inform policy development and direction. This work will also serve as a precursor to future work already being studied in linking data to other datasets within the healthcare field.

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