

## A SEISMIC Response to Infoway's Data Impact Challenge II:

*"How have antimicrobials been used in Island Health over the last 5 years?"*

### BACKGROUND:

Island Health provides health care to more than 765,000 people on Vancouver Island and surrounding areas in British Columbia through a network of hospitals, clinics, centres, health units, and residential facilities. In the early 2000's this regional health authority sought to consolidate their many information systems in several ways. Since 2009, all acute care facilities within Island Health's geographical region have utilized a single vendor, Cerner, for acute care and emergency, pharmacy, laboratory and other information systems such to facilitate better integration of clinical information. Administrative data, including those from the Admission, Data & Transfer (ADT) databases and CIHI's Discharge Abstract Database (DAD), are stored in a single Business Intelligence Data Warehouse (BIDW) since 2007. The data warehouse is a collection of source system data that is staged and dimensionally modeled for analysis and delivery. In 2012, the team started the journey to extract data from Cerner's information system and develop SEISMIC -- Surveillance and Epidemiology of Infections, (antimicrobial) Stewardship, Microbiology and Infection Control.

### RATIONALE & METHODS:

Vast amounts of clinical, laboratory and pharmacy data are created and stored within Island Health's information systems. These data can be used to monitor trends in pathogens and infections, assess appropriateness of antibiotics and laboratory tests, and look at related clinical outcomes in a population. Analysts and epidemiologists refine these data to provide information to guide quality improvement and strategic decisions. However, access and analysis of such data are limited by the constraints of current reporting methods, which are inflexible and costly to develop.

A dedicated group of clinical and informatics experts have developed SEISMIC, an extension of the current BIDW. This involves the extraction and remapping of laboratory and pharmacy data from Cerner and other sources to address a broad range of clinical questions regarding infections and antimicrobials. The answers provided will be tailored specifically for Island Health's population, and intended to be used for both quality improvement and research.

Multiple considerations and partnerships have been made early in development to ensure the success of SEISMIC. Clinicians, programmers and data analysts work closely together for an agile development process. Not only is this method faster, but it also ensures that the data gathered are correct and meaningful to for the clinical questions. Key stakeholders in Island Health's Research, Quality/ Patient-Safety, and Privacy departments have provided guidance to meet required standards for use and publications. Relationships with external experts and academics have been initiated to provide increased analytical capacity and techniques. This initiative is one of the most comprehensive analytical environments for clinical data in the province, and will serve as a model for other similar endeavors.

First phase development focused on drug information. While the primary purpose was to evaluate antimicrobial utilization, it can be expanded to all classes of medications. The sole data source is the

medication orders stored on Cerner pharmacy information system (PharmNet). This data comprises of all medications ordered on all inpatients at Island Health since 2009. The medications were mapped to both Health Canada's Drug Identification Number (DIN) and to the World Health Organization's Anatomic Therapeutic Chemical (ATC) classification system. Mapping to ATC codes allow the application of WHO's Defined Daily Dose (DDD) as a measuring unit into the data model. The drug model can be linked to other components of the BIDW, including the ADT and DAD. As of 2015, the BIDW consisted of 9 billion records organized into over 100 fact tables and 581 dimensions. This creates a powerful platform at which data can be analyzed on many different levels. The data is updated daily so is very close to real-time.

## FINDINGS

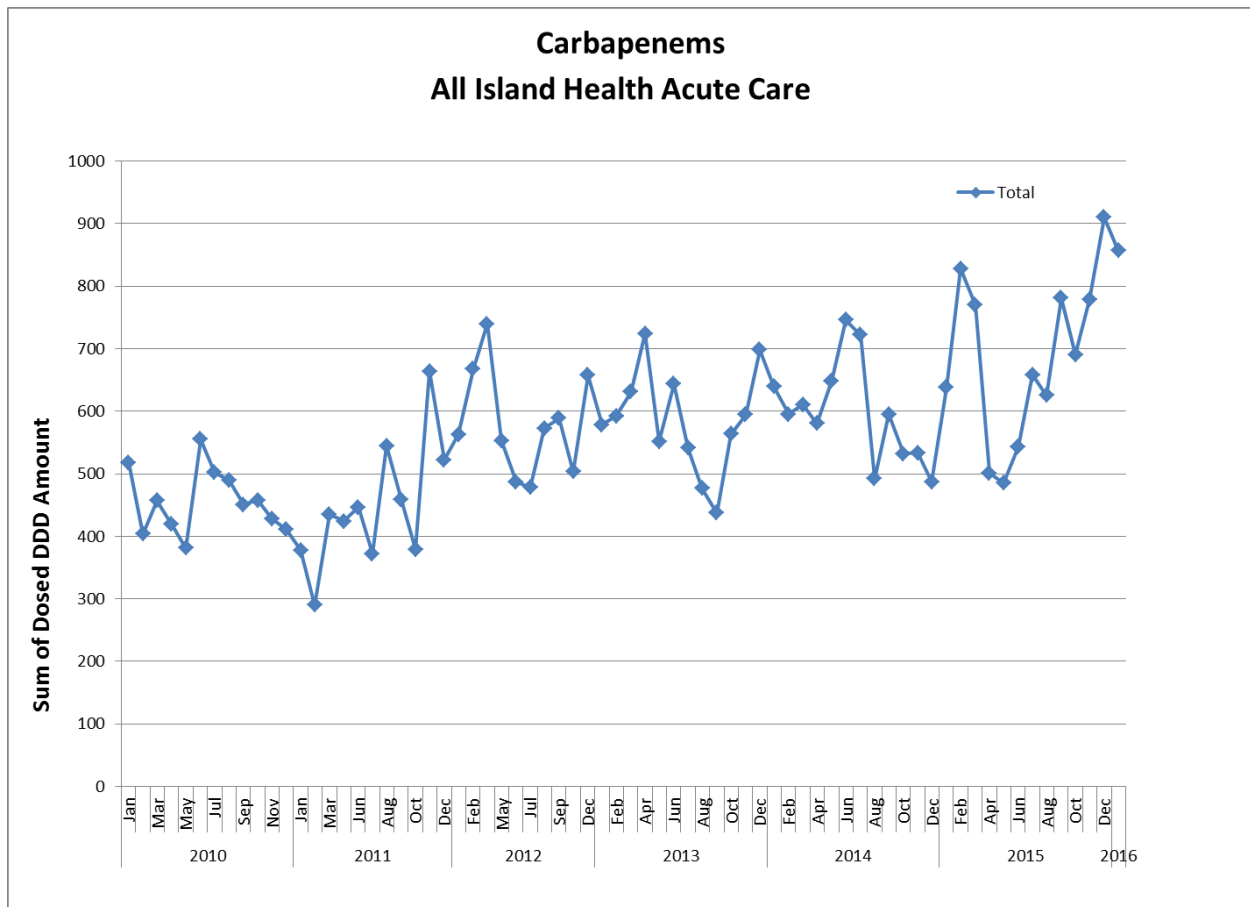
Pharmacy records representing over 100 million doses of medication given over 6 million patient-days since January 2010 are currently available for analysis. Approximately 8% of these are antimicrobials. The data can be assessed with multiple analytical software tools. However, a purpose built OLAP cube was constructed to allow a broader range of users and software expertise to analyze through Excel 2010 for Windows. This model is versatile and data are expressible in doses, days of therapy, unique orders, unique patients, and DDD per 100 patient-days. Context parameters include location down to unit (ward), date, time, patient age, gender, prescriber, route of administration (IV, PO etc), and care type (acute care, residential care etc.). The examples below are expressed in total DDDs so are not true rates. The data have been used by Island Health antimicrobial stewardship teams to establish baselines, program evaluation, and set organizational priorities. One interesting finding in the development and application of SEISMIC is the necessity of a data analyst who understands both the intricacies of health data and database models, and has the skills to use advanced query and analytical tools to address complex questions. Such personnel often may be hard to find and may need to be immersed into the data for a period of time before they can output an analytical product. Island Health realizes the potential of these tools and products and is in the process to increase its analytical capacity.

SEISMIC's data has several limitations related to being based on pharmacy orders. The ordering physician for a record is not reliable, as the most responsible physician for that patient's visit is the default choice. Hence, SEISMIC cannot be used for evaluating individual physician practices. Medication administration is overestimated as missed or held doses are not captured. Updates of Island Health's information system is underway to include computerized provider order entry and closed-loop medication administration. These additional data will allow SEISMIC to overcome its limitations.

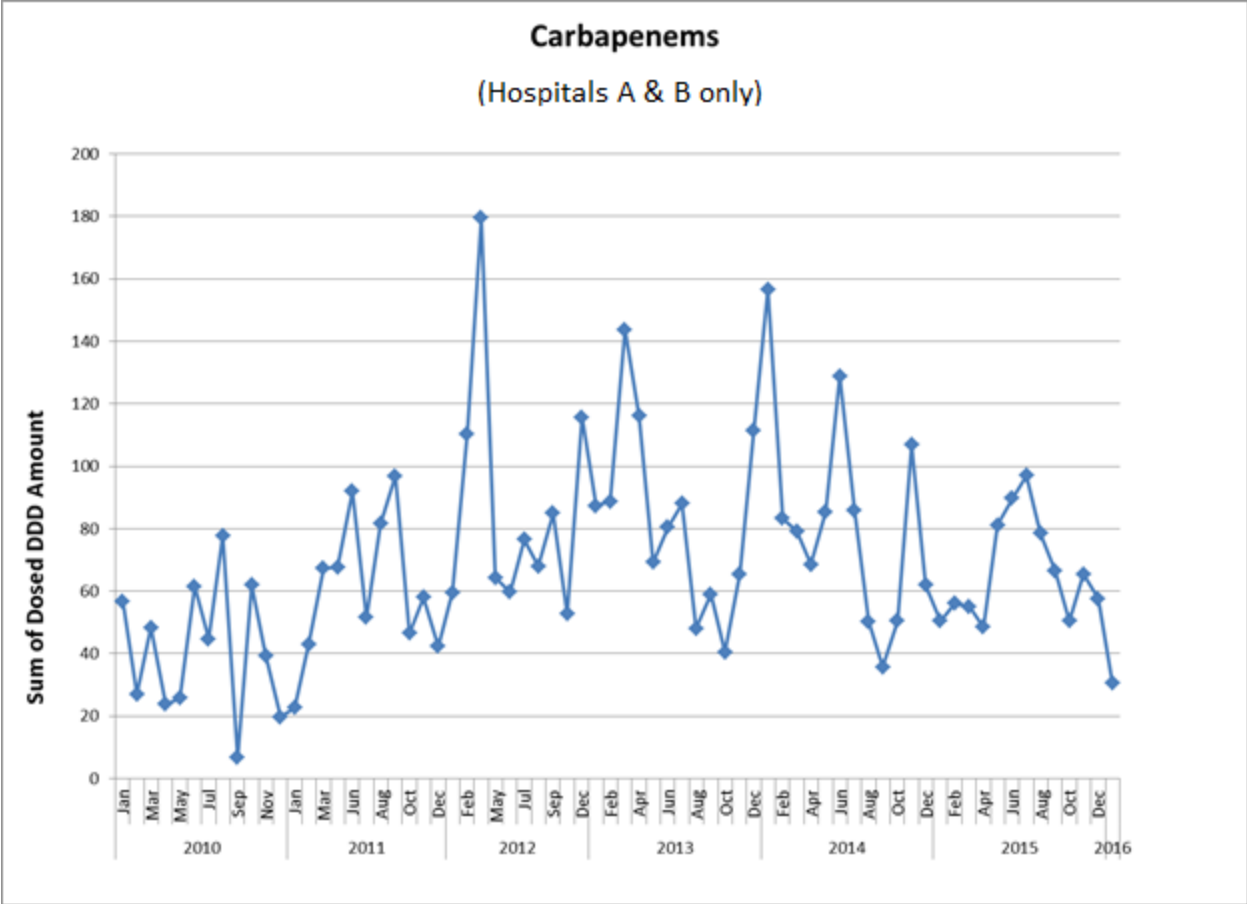
The Drug component of the SEISMIC database is an invaluable resource currently used for defining Antimicrobial Stewardship agendas and evaluating effects. In addition to the flexibility on how the data can be analyzed is the potential to look at drug utilization beyond antimicrobials. For example, there have been considerable interest in the use of antipsychotics and polypharmacy within the elderly. Plans are underway to utilize this database for many other drug categories for multiple purposes including work on polypharmacy risk reduction, medication reconciliation and a CIHR project aimed at defining "meaningful medication review".

## EXAMPLES

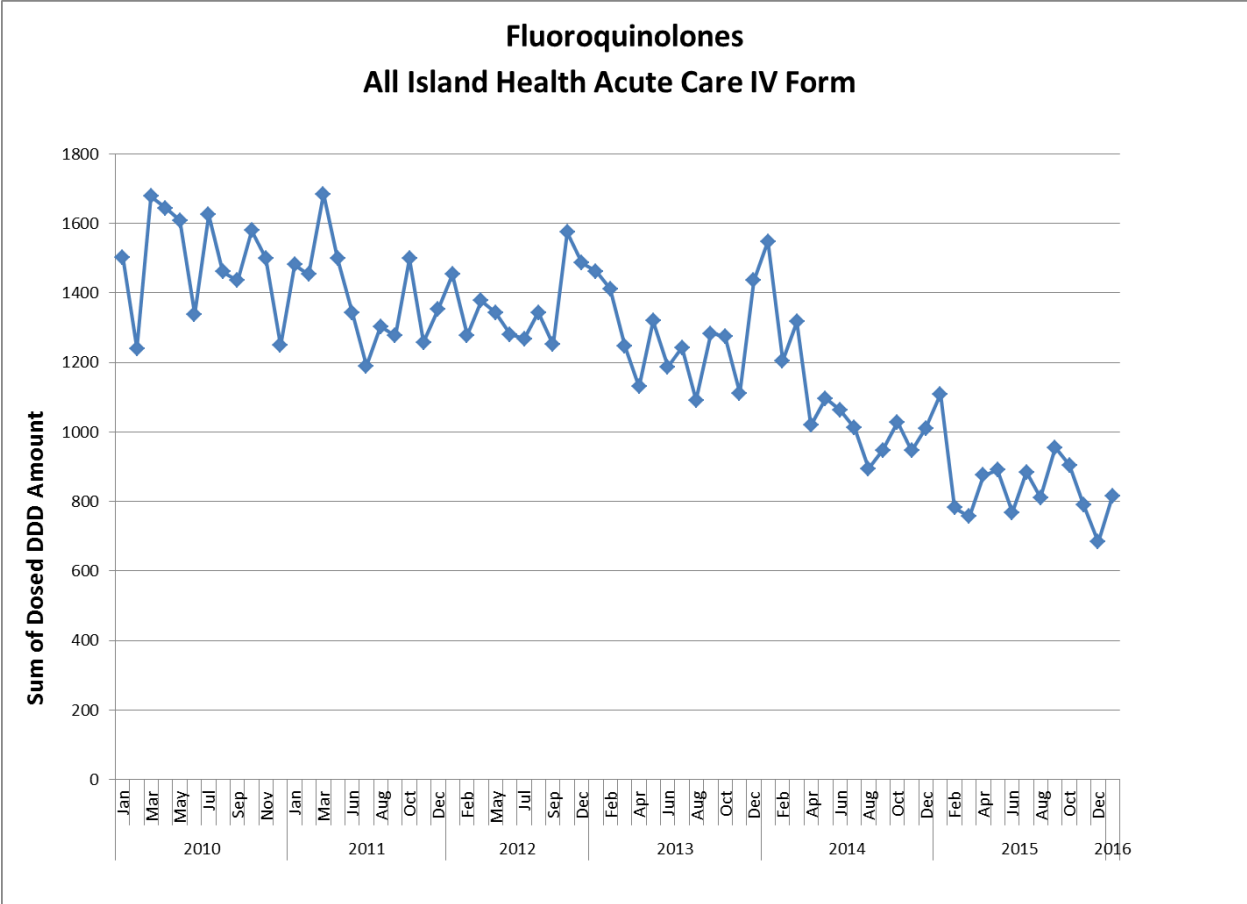
Below are three examples of the metrics produced by SEISMIC. The system can be analyzed in thousands of different combinations, each of them taking seconds to perform. However, these static pictures do not show the power of SEISMIC. If it will be helpful, the team will be happy to perform a demonstration of the analysis process for your evaluation.



**Figure 1** – This graph describes rising rates of carbapenem consumption from 2010 to the present for all of Island Health acute care sites looked at as a whole.



**Figure 2** – This graph describes carbapenem use at two selected hospitals. These hospitals have had the most intensive new Antimicrobial Stewardship efforts in Island Health starting in 2012-2013. The falling rates appear to be associated.



**Figure 3** – The use of the Intravenous form of all fluoroquinolones (mostly ciprofloxacin and moxifloxacin) has steadily fallen and has accelerated since the inception of more formal Antimicrobial Stewardship efforts.