Data Management and Data Analysis
By
Sisira T. De Silva
B00469552
sisira@dal.ca

Performed at
Population Health Research Unit,
Dalhousie University,
5790 University Avenue,
Halifax, N.S. B3H 1V7
Phone: (902) 494-6456
Fax: (902) 494-1597

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Acknowledgement and Endorsement:

First I want to express my deep gratitude to Mr. Mark Smith, Director of Population Health Research Unit (PHRU), for giving me this opportunity to work at Population Health Research Unit. This was a very unique experience and wonderful first step forward a career goal working in the health information field.

I want to deeply thank Ms. Yan Wang, Programmer/Data Manager, for remarkable supervision of my training. Her kindness and her availability have been a great help during the entire internship at Population Health Research Unit.

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Finally, I want to thank and my friendliness towards all the staff from Population Health Research Unit for providing me with a really friendly and enjoyable working environment during all four months. This has been a really pleasant time working with the PHRU staff.

I couldn’t complete the acknowledgments without thanking Dr. Raza Abidi, Director of Health Informatics and Dr. David Zitner, Director of Medical Informatics, at Dalhousie University, for the quality of training they provide for students during the Health Informatics program.

This report has been written by the author and has not received any previous academic credits at this or any other institution.

Due to the confidential nature of the “SAS” files I was working with, it is impossible to include them in this report.

Signed by Sisira T. De Silva
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Sisira T. De Silva
Executive Summary:

Health Informatics focuses on the application of computer information systems to health care and public health. A major focus of it is the support of information systems for reasoning, decision-making, and learning to support health care delivery, education, and management. The Health Informatics internship is an opportunity for the student to acquire on-the-job training at a health organization.

The author fulfilled the internship requirement at the Population Health Research Unit (PHRU) located at Dalhousie University. Earlier course work laid the theoretical foundation for success in the health informatics field but the internship provided setting for understanding how the theory can be applied in practice. Reinforcing the concept that health information must be constantly updated in order to maintain its relevance, the author acquired the skills necessary to perform this task through revising the databases. In order to do this the author had to be familiar with data extraction, statistical analysis, data interpenetration, and how to use relevant software applications.

Not only what was the author able to transfer concepts learned at school to the workplace setting he will be able to transfer skills gained through his internship to his future academic pursuits.

After completing the internship the author realizes that to become more confident he must familiarize himself with variety of computer operating systems and large databases.
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Introduction:

Health Informatics is an integrated research and learning program with health as its focus and information technology as the enabler [1]. It teaches students the ability to use health information related technology and to facilitate better communication between health providers and IT professionals to improve the outcome and the delivery of healthcare. Students are provided with an understanding of the health care system plus a conceptual understanding of the science and the methodology for health informatics [2].

The Population Health Research Unit (PHRU) is a Dalhousie University-based research and support group conducting systematic research into population health, health services and their inter-relationships. Through an internship at PHRU the author planned to learn about and gain practical experience in health informatics.

Objectives of the internship at PHRU:

1. To identify and understand the informatics concepts driving the host institution (PHRU).
2. To describe the challenges associated with development, maintenance, and evaluation of health information systems.
3. To recognize, discern and appraise the utility of products and services offered by the host institution (PHRU).
4. To ascertain and learn practical skills.
5. To use statistical software programs, and interfaces.
6. To have an opportunity to apply theories, ideas, principles, and skills learned.
7. To understand the complex relationships within health-care organizations.
8. To maintain and update of Databases (Research Data Repositories) of host organization (PHRU).
9. To maintain existing websites and to develop new WebPages for various institutions.
10. To perform data extractions, statistical analysis and data interpenetration.
11. To identify how the lessons learned can enhance a career in informatics.

The internship is an opportunity for the student to acquire on-the-job training at a leading health organization [1].
Description of the Organization:

The Population Health Research Unit (PHRU) is a university-based research and support group conducting systematic research into population health, health services and their inter-relationships. PHRU is committed to advancing the level of knowledge and developing innovative research methods for the betterment of the health of the general population in a cost effective manner. Its efforts support both individual researchers and research teams addressing larger projects. PHRU staff work with government bodies, other research institutions, granting agencies, public health boards, as well as the private sector [3].

PHRU was established within Dalhousie University’s Department of Community Health and Epidemiology in 1993 to meet the growing need for data and research support in population health, health services utilization and their interrelationships. In a time of health care reform, spending constraints and an expanding world of therapies and technologies, the need for efficient and effective support services for population-based research has never been greater. To facilitate the growth of research in these areas, the Province of Nova Scotia has supplied PHRU with complete Medicare, Pharmacare and Hospital files suitable for research purposes. The Unit has also been supplied with Workers Compensation records and has access to a variety of other data sources including clinical databases and large-scale population surveys [3]. The individual databases have been linked to create a comprehensive data system, which provides unparalleled opportunities for research in the health and social sciences:

- Evaluation studies
- Needs assessments
- Cost-benefit and cost-effectiveness analyses
- Compliance studies
- Determinants of health studies
- Health status analyses
- Patterns of care and practice studies
- Services and technology utilization studies
- Health economics & Pharmaco-economics
Data access procedures and policies:

To ensure fair and equitable access to the databases and to preserve the integrity and confidentiality of the data, a number of policies have been adopted.

- Researchers are required to submit a written request indicating the nature of the data requested, its intended use and the extent to which it will be shared with others.

- All users are required to sign a confidentiality agreement and all access is governed by the pricing policies of the Unit. Staff within PHRU will provide expert services for data interpretation and explanation.

- Micro data in the form of customized research files may be released to researchers upon approval of the PHRU Management Committee. All such data files will be rendered anonymous and subjected to special release conditions.

- The linkage of PHRU data to external research data sets requires special protocols to ensure the security of the Department of Health procedure for encrypting patient identifiers and to protect the confidentiality of subjects.

- The PHRU Database System provides efficient and effective access to a comprehensive data set, which creates unique opportunities for population health and service utilization research in Nova Scotia. The system provides information resources that are at the leading edge of the North American population health community.

- All new projects coming into PHRU will be reviewed by a committee that will convene once a month. For more information about using PHRU data, please review the Data access procedures for obtaining access to PHRU data.
Objectives of Population Health Research Unit:
The objectives of PHRU are to encourage research and develop health data resources for academic researchers, government and other clients. In accordance with the policies outlined herein PHRU manages (for research purposes) the following Nova Scotia databases including, but not limited to:

- MSI Physician Services
- Hospital Admission/Separation/Day Surgery
- CIHI Discharge Abstract Database
- MSI Seniors’ Pharmacare
- MSI Community Services Pharmacare
- Physician Demographics
- MSI Master Registration File
- Vital Statistics
- N.S. Department of Environment Data
- Community Services Family Benefits Database
- Mental Health Outpatient Information System
Description of the work and how it relates to Health Informatics:

Title during internship: Analyst

Role and Responsibilities:

1. To maintain and update the Population Health Research Unit Databases (PHRU Research Data Repositories).
2. To maintain and update “What’s New?” web page of Population Health Unit.
3. To contribute to research projects by performing data extractions, statistical analysis and data interpenetration; as well as acquired hands-on research experience relating directly to today’s major health problems.
4. To produce technical reports and prepare data for presentation at scientific meetings for both academic and government audiences.
5. To apply IT Project Management skills effectively to develop questions and solutions as well as to implement solutions effectively.
6. To develop websites for other institutions.
7. To apply principles of project and information management within projects on daily basis.
8. To become familiar with additional software applications

Elaborating upon these roles and responsibilities:

1. Maintained and updated the Population Health Research Unit Databases (Appendix A):

   1.1. Provincial Health Utilization databases:

   1.1.1 Physician Billings Database (MED)
   1.1.2 CIHI Hospital Discharge Abstract Database (ASD/CIHI)
   1.1.3 Mental Health Outpatient Information System Database (MHOIS)
   1.1.4 Senior’s Pharmacare Prescriptions Database (CSPHARM)
   1.1.5 Community Services Pharmacare Prescriptions Database (CSPHARM)
1.2. Population Databases

1.2.1 Insured Patient Registry Database (MASTER)
1.2.2 Postal Code Geography Database (WHERE)
1.2.3 Licensed Provider Registry Database (DOCTOR)
1.2.4 Vital Statistics Deaths Database (VITAL)

1.3 Health Status Determinants Databases

1.3.1 Canada Censes Survey Database (CENSUS)
1.3.2 Nutrition Survey Database
1.3.3 National Population Health Survey Database
1.3.4 Nova Scotia Health Survey Database

**Steps taken to update the PHRU Research Data Repositories:**

I. Created SAS data files using VMS software and saved to GEORG4.BP.DAL.CA server using UltraEdit software.

II. Used five SAS files to create the final HTML documentation file using VMS software:

- **CONFIG.SAS file** – This is online documentation configuration file. It includes information such as library where SAS file is located, name of the file is documented, name of 1st documentation file, name of 1st HTML output file, title for documentation.

- **PASS1.SAS file** - Program to create an HTML formatted output file of proc contents, proc means, proc freq’s, proc tabulates, and proc format FMTLIB table for documentation purposes. Footnote numbers are included in the FORMAT program. MSI and Hospital numbers are excluded from the report for confidentiality reasons.

- **PASS2.SAS file** – Program to read the log file from the last step to extract IDX information for modifications to the HTML file. What this program does is identify all the objects that were output to the HTML file and assigns a
sequential IDX# to each. It builds a table (array) and then uses that to modify
the HTML output.

- PASS3.SAS file – Program to read the PASS2 output, build an IDX# table for
  the FORMAT entries in the FMTLIB output, and then modify proc content
  entries to link to the FORMAT table.

- FINAL.SAS file – Program to handle footnotes. If no footnotes are required
  just remove all of the text between <pre> and </pre> in footnotes.htm.

III. Created online data documentation (Selected which users can view/edit based on
their role. Identified the taxonomy term associations; specified the taxonomy terms
with which the user wishes to associate the node).

IV. Uploaded the final HTML documentation file to PHRU website.

V. Saved copies of final HTML documentation file and printable version of final
HTML documentation file to METADATA server.

Description of the PHRU Databases (Research Data Repositories):

The Physician Billing database contains administrative records for each insured health service
rendered by a physician and paid for by the Nova Scotia provincial healthcare system
(Appendix B). The data include:

- Patient demographic information (e.g. birth date, sex, postal code)
- Physician information (e.g. specialty, ID number for linkage to the physician registry)
- Diagnostic (only one from 1989-1996, up to three from 1997 forward) and procedure
codes
- Costing information (i.e. the amount paid for each billing)

Therefore, Physicians delivering health services in Nova Scotia can be remunerated by Nova
Scotia Medical Services Insurance (MSI) in either of two ways:

- MSI by Fee-for-Services
- MSI by Alternative Funding.
The CIHI Hospital Discharge Abstract Database (ASD/CIHI) has two distinct data series. Such as ASD (Admissions /Separations/ Day Surgeries) and DAD (Discharge Abstract Database) (Appendix C). The database contains diagnostic codes from ICD -9 format from 1989-2000 and diagnostic codes ICD-10 format from 2001 forward. Both ASD and DAD data series contain individual patient-level information including:

- Patient demography (age, gender, location, etc)
- Attending physicians
- Diagnoses and procedures performed

In addition, the newer, CIHI database contains information on

- Service transfers while in hospital
- Specialty services received (e.g. physiotherapy, occupational therapy)
- Case complexity (e.g. resource intensity weight)

The MHOIS, Mental Health Outpatient Information System Database, facilitates clinician access to patient data and enables case management and support staff to quickly edit client data (Appendix D). The system was implemented at all Mental Health Clinics across Nova Scotia in 1992. The system uses a form called “Mental Health Outpatient Record” or “Event Form “. The submission of the form is a clinician’s responsibility and it contains client encounter information. Such as:

- Registration and Re-registration
- Assessment
- Repeat Transaction
- Closure

PHRU maintains anonymized and de-identified copies of this information for research purposes.
The Senior’s Pharmacare Prescriptions database contains information about pharmaceutical prescriptions paid for by the Nova Scotia provincial government to beneficiaries over the age of 65 (Appendix E). The database includes

- Demographic information (gender, birth date, county, postal code).
- Provider information (prescribing physician identifier, specialty, and county).
- Pharmaceutical (Drug Identification Number (DIN), Anatomical Therapeutic Classification (ATC), compound indicator, quantity of drug dispensed).
- Costing data (prescription cost, amount paid, copay amount, amount of markup).

The Community Services Pharmacare database contains information about pharmaceutical prescriptions paid for by the provincial government to beneficiaries on provincial income assistance programs (Appendix F). All individuals in the database are under the age of 65.

The Insured Patient Registry contains longitudinal information about every individual registered as a beneficiary of provincial MSI healthcare services (Appendix G).

The database includes:

- Demographic information such as gender and date of birth.
- Insured Health Benefits program eligibility start / end dates
- Patient Geography (county, postal code, Canada Post Community)

The WHERE, Postal Code Geography Database, contains additional geographic information derived from the patient's postal code. The database employs the PCCF+ (Postal Code Conversion File) programs to assign specific geography codes to records so that geography-specific (e.g. census information) can be linked to these records. In areas where postal codes do not map exactly to other geographic boundaries (in rural areas, for example), the geographic code is assigned probabilistically using the relative population weights of the surrounding areas. This WHERE geography database is used for analyzing population health data by various geographic units, including dissemination areas, census tracts, census subdivisions, and metropolitan-influenced zones (Appendix H).
The Licensed Provider Registry contains demographic information about the ‘population’ of health services providers (currently only containing physicians that are registered and licensed to practice in Nova Scotia) (Appendix I). It includes information for each physician such as

- Date of birth, gender, place of birth, geography.
- Education including year of graduation, name of school, area(s) of specialization.
- Eligibility start / end dates (period during which physician was licensed to practice in Nova Scotia).

Vital Statistics provides PHRU with data around all mortalities in Nova Scotia (Appendix J). It includes:

- Demographic information such as gender, date of birth, date of death, county of residence, hospital, birth province, province of residence, marital status.
- Information around the mortality event such as the place of injury, attendant type, and whether a medical exam or autopsy was performed.
- Diagnostic data such as the nature of injury, causes of death, and underlying cause of death.

The Nova Scotia portion of the census data conducted by Statistics Canada every 4 years housed at PHRU is broken down by geography, providing a complete census profile for each dissemination area in Nova Scotia (Appendix K). The database contains information about

- Demography (age, sex, location).
- Number of households, dwellings and families.
- Socioeconomic indicators (income, unemployment, housing, occupation)
- Languages, ethnicity, religion.
Nutritional Survey provides PHRU with data:

- Population demographics
- Diet/ food composition patterns
- Knowledge / opinions related to diet
- Food preparation method

National Population Health Survey provides PHRU with data:

- Population demographics
- Health status
- Use of health services
- Determinants of health
- Socioeconomic indicators

Nova Scotia Health Survey contains information about:

- Population demographics
- Health status
- Determinants of health
- Socioeconomic indicators

2. Maintained and Updated “What’s New?” web page of Population Health Unit (Appendix L). The web page contains links to both external and internal events of other organizations such as workshops, seminars, bulletins, reports, fundraising events etc.

Therefore, it gives an opportunity for users to collect and manage health information of the important events of other institutions through PHRU website.

Adding links required modification of the index page using HTML/PHP codes and uploading various types of pictures and PDF files to the server using FTP software.
3. Contributed to research projects by performing data extractions, statistical analysis and data interpenetration; as well as acquired hands-on research experience relating directly to today’s major health problems. Two examples of this are:

(i). “Growing Together”, a program designed to promote healthy child development in strong families and supportive communities. This research was a joint partnership between the Dartmouth Family Resource Center in North Dartmouth, the Family Place Resource Center in Northside Victoria, the IWK Health Center and Dalhousie University. This study tested how well the program assisted parents in getting to know their newborns and promoting healthy child development. The information from this study will help policy makers to understand how best to support young families. For this the author used SPSS statistical software to analyze following data:

- Family-Centered information
- Child-Centered information
- Child literacy information
- Caregiver’s childhood experiences
- Difficult life circumstances (DLC)
- Community life skills scale
- CES-D scale
- Parent protective factors
- Measurement of language skills in infancy (Reel-2 scale)
- NCAST teaching scale
- Home observation for measurement of the environment

Involvement in this project allowed the author to gain a greater appreciation for how to acquire information, how to analyze it, and how to disseminate it. The author enhanced his ability to integrate data from multiple sources, and not only combine them, but to determine its validity and quality so the data becomes useful information.

The results could be used for policy development, program planning and evaluation purposes.
(ii). Surveillance of Mood Disorders and Anxiety Disorders in Nova Scotia from 2001 to 2005. Using Provincial / Territorial administrative databases, this study was conducted by the Center for Chronic Disease Prevention and Control, which is part of the Public Health Agency of Canada.

The author was involved in preparation of the following reports in order to interpret the data on Mood and Anxiety disorders:

- Sex and Age distribution of individuals with treated disorder for each year.
- Means and Median age of individuals with treated disorder for each year.
- Prevalence of treated disorder for each year
- Prevalence of treated disorder by sex for each year
- Prevalence of treated disorder by age group for year
- Among individuals with treated disorder, proportion who saw each type of service provider for each year.
- Among individuals with treated disorder, proportion who saw each type of service provider by sex for each year.
- Among individuals with treated disorder, proportion who saw each type of service provider by Age group for each year.
- Among individuals with treated disorder from physician billings, the number of visits to a physician for each year.
- Among individuals with treated disorder from hospital separation, the number of hospitalization for each year.

The results are to be used for policy development, program planning and evaluation purposes.
4. Produced technical reports and prepared data for presentation at scientific meetings for both academic and government audiences.

5. Applied IT Project Management skills effectively to develop questions and solutions as well as to implement solutions effectively.

6. Developed website for “National Diabetes Surveillance System” (NDSS) using PHP language (Appendix M). The website contains total of 10 WebPages in both English and French. The first page is a portal page for the NDSS with links to the home pages in both English and French. The home pages have links to the sub pages. The visitor count and date functions are included.

**Steps taken to design the website:**

A website design is very important as it displays the potential of the body it represent. A second-rate design webpage would repel most people from the site and this would eventually effect the institution. Therefore, the author has considered the following rules “Dos and Don’ts” for the web design [4]:

- **The scope of design web site**- Do check the scope of the web site you are designing. It is very important that the target of the web site is clearly in your mind when you are designing a web page. Don’t design heavy sites with several links if it is used for personal purposes or representing a small business. Most online sites are design with the aim to be user friendly and easy to surf.

- **The layout for design websites** – Do the designing of the website according to the requirement of the websites. Heavy animations and images often imposes heavy burden on the site. Such websites consume much time to load and moist people quickly lose interest in such websites. Don’t ever try to heavily decorate a web page to impress people. It is evidently proven that more people are attracted to simpler built web site as compare to those which are heavily filled with images, sounds and animations.
• **The compatibility of design websites** – Do check that the design website is compatible with the major browsers which are being used in the world. It is also necessary that when you add animations and designing to your webpage you are aware what type of graphics the browser support and which animation won’t work on the internet. Don’t upload your website on server if they are not run on most common browsers such as Internet Explore and Netscape Navigator. Always check the authenticity of a server before uploading the work online.

• **Documentation of design websites** – Do make sure that the text on your design website is relevant. It is very necessary that the documentation on the design website is easily understandable and to the point. The uses of keywords while describing the contents of the website is also important as it keeps the focus of the reader to the topics on the design website. Don’t fill your design site with useless and irrelevant text as this diverts most of the traffic from the web site. The amount of information or any knowledge which is provided on the design website should be done in a professional manner.

• **Safe and secure mechanism** – Do make sure that your website is safe from viruses and hackers. It is very necessary that latest security protocols are implemented with the website design. Don’t encourage the sharing security protocols and protection mechanism with the general public.

7. Applied principles of project and information management within projects on daily basis and worked in fast paced team environment at PHRU.

8. Became familiar with additional software applications:
   • **VMS Software** - VMS is a multi-user, multiprocessing virtual memory-based operating system (OS) designed for use in time sharing, batch processing, real time (process priorities can be set higher than OS kernel jobs) and transaction processing (Appendix N). It offers high system availability through clustering, or the ability to distribute the system over multiple physical machines this allows the system to be "disaster-tolerant" against natural disasters that may disable individual data-processing facilities [5].
• **UltraEdit Software** - UltraEdit is a commercial text editor for Microsoft Windows created in 1994 by IDM Computer Solutions (Appendix O). The editor contains tools for programmers, including macros, syntax highlighting, code folding, file type conversions, project management, regular expressions for search-and-replace, a column-edit mode, remote editing of files via FTP, interfaces for APIs or command lines of choice and more.

• **SPSS Software** – SPSS is a modular, tightly integrated, full-featured product line for the analytical process—planning, data collecting, data access, data management and preparation, data analysis, reporting, and deployment and widely used in research and for teaching of statistical methods.

• **SAS Software** – SAS system is an integrated statistical package that allows user to do statistical analyses—such as descriptive statistics, multivariate techniques and time series—using a consistent set of commands.

**Other activities during internship:**

In addition to the work, the most valuable experience during the internship was the PHRU staff meetings where we presented our progress reports and discussed about the work that we participated. The author attended three staff meetings and one seminar at PHRU. It was a great opportunity to learn how to discuss progress reports of health informatics because this was the first opportunity the author has exposed to Health Informatics work. The seminar that the author has attended has given an opportunity to familiarize with new software.
Discussion of the problem that the author have analyzed and the corresponding solution:

<table>
<thead>
<tr>
<th>Problem encountered</th>
<th>Reason for the problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to change the format for data documentation nodes in the PHRU websites.</td>
<td>The system uses “Drupal” software to manage the data repositories.</td>
</tr>
</tbody>
</table>

Proposed Solution:

At the moment the system uses “Drupal” software to communicate between PHRU website and the PHRU data repositories. This makes it impossible to change the format for the data documentation nodes in the PHRU websites. Though this does not affect the integrity of the data it does make it more difficult to work with.

Therefore, it may be beneficial to redesign the system so that the PHRU website directly interfaces with PHRU data repositories. The proposed system could be restructured using PHP language and MySQL Server or MS SQL Server.
Conclusions:
The past four months at the Population Health Research Unit was an excellent opportunity for author to gain some hands on experience in the health informatics field. It gave the author an opportunity to work as a health information analyst, not just a student. The author acquired many new skills and developed many already existing skills including innovativeness and creativity in web-design, data-analysis using SAS/SPSS software, working in a team based environment, dealing with management and customers, and report writing. Although these skills were developed in the work force, the author has found that they could easily be applied at school. The author has found that his ability to absorb material has drastically improved, as has his time management ability.
**Recommendations:**

The author’s experience at Population Health Research Unit has been invaluable. Author thoroughly enjoyed his position and learned a great deal about all aspects of a major health research institution.

However, reflecting upon the internship experience the author identifies a couple of areas in which he would like to strengthen his knowledge. These include:

- To be familiar with UNIX /LINUX operating systems. The author discovered that such knowledge would be helpful in the health institution environment because many of these places rely on these systems.
- To gain experience working with large health databases. The author found that health informaticians working in the field have the ability to compile information from large databases.

Further, the author suggests that all students do an internship whether they are pursuing master thesis or not. Work experience while in school would significantly increase the chances of employment after graduation.
**Reference:**


Appendices:

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