

Creation, Design and Implementation of TOHAP Database

Saleh Rajaeian - DDS, MHI Candidate

Executive Summary: The Oral Health of our Aging Demographics (TOHAP) is a study being lead by clinician researchers in the Faculty of Dentistry at Dalhousie University; Halifax, NS. The primary objective of this three-year (2008-2010) provincial study is to develop a clearer picture of how the oral health and expectations of the “baby boomer” (45y-64y) generation differ from those preceding them (65y+) for the purpose of planning and policy creation. Currently there are no national or provincial databases to reflect oral health status and treatment needs of the aging Canadian population. This Nova Scotia study will be the first of its kind to develop clear baseline measures related to clinical oral health status and quality of life. It is estimated that 1200 samples will be examined in this survey across the Nova Scotia.

The TOHAP database is a developed relational database system to capture, store and retrieve information related to clinical exam component of the survey; and also this system is able to incorporate and adapt results from the interview database (that will be created by a third party marketing company) into the existing clinical database. With appropriate data mining techniques and statistical analysis of the data captured and stored in the system, the TOHAP researchers will not only be able to determine the sample’s health status but also measure the other oral health outcomes. MySQL is the relational database management system (RDBMS) using in the TOHAP survey. The web interfaces were created for data entering into MySQL Server. HyperText Markup Language (HTML), PHP, Cascading Style Sheets (CSS) and JavaScript were used in designing most of the web pages. phpMyAdmin is also used to connect the TOHAP database in order to manipulate the MySQL Server.

Acknowledgement and Endorsement

I would like to take this opportunity to thank Dr. Debora Matthews and Dr. Joanne Clovis for their supervision on this internship, Dr. Grace Paterson for her valuable help to take this internship, and Ms. Deirdre Harvey for her support during this internship. I would also like to thank the TOHAP executive teams specially Ms. Rebecca Green and Ms. Martha Brilliant for their assistance during the period in which this project was conducted.

Table of Contents

Content	Page
Organization.....	3
The Author Responsibility.....	3
Introduction.....	4
Impact of Oral Health.....	4
Seniors and Oral Health.....	5
Mid-Life Bulge and Oral Health.....	6
Why Nova Scotia?.....	7
The Purpose of study.....	8
Data Collection Procedures.....	8
Questionnaires.....	8
Clinical Examinations.....	9
Overview of the TOHAP Database Architecture.....	10
MySQL Database Server.....	12
phpMyAdmin.....	12
Web Interface (Clinical exam questionnaire).....	13
Conclusion.....	18
Recommendations.....	19
References.....	20

Organization:

Faculty of dentistry at Dalhousie University, Halifax, Nova Scotia.

Supervisor: Dr. Debora Matthews**Signature:****Date:****The Author Responsibility:**

The author was employed as a Health Informatics Intern to:

- Create, design, and implement a web-based database using MySQL as the relational database management system (RDBMS).
- Design and implement web-based interfaces to enter data into the TOHAP database.

The health informatics component of the TOHAP project was to identify the flow and use of information in the TOHAP survey that would help the researchers to evaluate the oral health status and the outcome measurement of participant samples. And like the saying goes, *you can't manage what you can't measure*. And the key to this project was to acquire data and standardize them in a manner that would permit or facilitate easy evaluation.

1-Introduction

Historically, the oral cavity has been dissociated from the rest of the body when evaluating health status. Yet, without oral health one can not be truly healthy.(1)A clear understanding of baseline oral health status and treatment needs is essential to establish oral health priorities that will contribute positively to health throughout the lifespan. Currently, there are no data to reflect the oral health status or treatment needs of people who are living in Nova Scotia. Without these basic data, it is difficult to answer complex research questions, to determine how and where to direct education and treatment interventions, or to affect policy change. The questions regarding appropriate interventions for older adults are complicated by the unknown impact of the aging baby boomer generation on the need and demand for oral care.

2-Impact of Oral Health

Known impacts of oral health on the quality of life, pain and disability, and chronic diseases (2) indicate substantive health and human costs created by inattention to oral health.(3) Research has identified important association between oral and general health. Tooth loss and pain from tooth decay result in problems chewing. This is linked to low body mass index and involuntary weight loss, which in turn leads to increased morbidity and mortality among affected individuals.(4)Patients with untreated or poorly controlled diabetes are more likely to have periodontal disease (bone loss around teeth) and gingival (gum)abscesses.(5) Studies have also shown the converse; that the maintenance of periodontal health can assist in controlling blood sugars of both insulin dependant and

non-insulin dependent diabetic patient.(6) Preliminary research suggests individuals with untreated periodontal disease are at increased risk of cardiovascular diseases.(7)The need for treatment of periodontal disease in the general population is underscored by the increasing prevalence of periodontal disease with age. It is estimated that at least 35% of the dentate U.S adults aged 30 to 90 have periodontitis, with 21.8% having a mild form and 12.6% having a moderate or severe form.(8)The prevalence increases with age, affecting 30% of those age 15-24; this increases to over 70% in the population from ages 45-54 years. There has been some research measuring the oral health of various communities within Canada (9,10) but there are no provincial or national databases to reflect oral health status and treatment needs of the population at large.

2-1-Seniors and Oral Health

The aging population is expected to have a major impact on all aspects of health care delivery. According to 2001 census, Canadians are living longer. They retain more of their natural teeth than in previous generations, emphasizing a need for greater understanding of oral health throughout the lifespan. As seniors are not a homogeneous group, there is a need to study the oral health status and needs of seniors in different living conditions and levels of independence. Of particular significance is the fact that within the seniors' cohort itself, 85 and over is the fastest growing segment. While people aged 65-74 tend to resemble those in age groups under the age of 65, those 85 and over are most likely to be characterized by many of the conditions associated with old age such as chronic disease, frailty and functional dependence. Utilization of health care

services increases for this age group and they have the highest representation in long-term care (34%). Those in the 75-84 age group are transitioning between young /old and old/old with respect to health conditions and only 9% live in long-term care.(9)Therefore it is interesting to learn about the oral health status, needs and oral health utilization practices of this transitioning and largely community-dwelling sector of Canada's elderly population.

2-2-Mid-Life Bulge and Oral Health

The large population of people between 45-64 years of age will ultimately lead to a large bulge in the senior population. This future seniors cohort, known as the "mid-life bulge" consist primarily of "baby boomers" born between 1946 and 1964. Demographers estimate the percentage of people aged 65 and older in Canada will rise from 13.2% in 2006 to 14.4% in 2011, and 23.4% in 2031, placing increased demand on Canada's social programs.(10) Baby boomers will require more dental care than previous cohorts. Unlike previous generations, baby boomers will enter their senior years with most or all of their natural teeth, creating a different set of oral health needs and disease patterns from previous generations.(10)The presence of natural teeth increases the risk of gingival recession, which may lead to increased root caries, the risk of periodontal diseases, and problems associated with wear. They will have more complex restoration needs, since their dentists will have work on teeth that have been restored at least once already. Additionally, while those in this group enjoy lower mortality rates and better general health for their age than previous generations, there is a higher incidence of diabetes

compared to previous cohorts, increasing the risk of diabetes-related oral diseases, such as periodontitis, soft tissue lesions due to slowed healing, and candida infections.

Midlife Canadians are also expected to be more frequent and demanding consumers of dental services than past generations, having come of age in an era of economic prosperity that shaped much of their existence and expectations. A number of studies have already demonstrated that early mid-lifers consult with a dentist and use dental services more frequently than their older counterparts. Being the first cohort to benefit from preventive philosophies in health and dentistry, those who are currently in their mid-life years are expected to be more interested in aesthetic dental procedures than their predecessors.(8)Given these factors, health systems policy planners in Canada must be aware of , and prepared for, the variety of conditions and challenges that will be posed by this group.

3-Why Nova Scotia?

Nova Scotia provides an optimal geographic location for studying this issue. According to 2006 census, 13.7% of the population is over the age of 65, representing the oldest population in Atlantic Canada and the third oldest in Canada. Over half of Nova Scotia's seniors reside in rural areas, mimicking the national urban/rural profile.

4- The Purpose of study

This research can determine oral health status, service utilization and care needs of adults aged 45 and older in Nova Scotia, and to determine the role of demographic variables within the study population. The initial objective of this study is to develop a clearer picture of how the oral health end expectations of new generation (midlife bulge) differ from those preceding them for the purpose of planning and policy creation.

This study will be used a cross-sectional observational survey of the oral health status, both clinical and quality of life, of adults aged 45 and older through interview and clinical examination.

5- Data Collection Procedures

This study samples randomly from all adults over the age of 45 living in Nova Scotia. This population includes those living in the community and those living in LTC facilities. The sampling strategy is slightly different for these two groups. To accommodate working adults and to ensure maximum response rate, adjustments will have to be made for the timing of both clinical examination and the telephone survey.

5-1-Questionnaires

The questionnaires will be administered through a telephone survey to community dwelling adults by trained interviewers by using CATI program. Preparing an initial call list for the community living adults can be performed by a telephone marketing company.

To ensure proportionate representation by urban and rural residents and by age groups 45 years to 64 years and 64 years and older, a stratified sample will be randomly selected from call list. Alternate selections will be determined for negative telephone response. Those who consent will be given appointments for a clinical examination. A few residents of long-term care facilities will have telephones; a two-stage cluster sampling technique will be used. Randomly selected facilities will be drawn from within strata of urban and rural facilities. Managers from each facility will be contacted to obtain lists of residents who may be contacted directly or through a guardian to obtain consent for the clinical examination and follow-up interview. Representative samples will be drawn in each facility using a fixed interval, random starting point methodology. Minimizing non-response bias can be achieved through response enhancement methods.

Although web-based surveys are an economic way to gather data we do not expect a large proportion of our retired population to have access to the Internet. In addition, web-based surveys may cause bias selection and can impact on this study results. For residents of long-term care facilities the questionnaire will be administered in face-to-face interviews. The questionnaire will take 15-20 minutes to complete either by telephone or in face-to-face interviews.

5-2- Clinical Examinations

The clinical examination consists of an intra-oral examination only. Treatment will not be provided. In the community dwelling adults, each person interviewed will be asked to participate in the clinical examination portion of study. For those who are interested, an

appointment will be arranged at a local site-either a LTC facility or other local center. For those living in LTC, clinical examinations will be performed on site, once consent has been obtained. In residences or communities where standard dental operatories are available, participants will be examined in those rooms. Where these rooms are not available, mobile equipment will be used. This examination takes 15-20 minutes per subject, on average, depending upon the number of teeth present.

Based on the description above on TOHAP survey, it is clear that there are vast quantities of data to be captured in order to analyze for statistical purposes. These clinical exam data need to be recorded at different dental clinics across Nova Scotia, simultaneously. Under these circumstances a web-based database was proposed.

6- Overview of the TOHAP Database Architecture

The TOHAP database is a password-protected and web-based database which multiple users can access simultaneously and fill out the clinical exam questionnaire.(Fig. 1) The database consists of two different components. The first one is a remote database, which has been created to store all of the data collected during the TOHAP study. The second component consists of clinical examination forms whereby users can communicate with the remote database. Users can enter required information into the questionnaire and then submit them into the remote database. Once all sample examinations are performed, records can then be exported from the TOHAP database for statistical purposes.

MySQL is the relational database management system (RDBMS) using in the TOHAP survey. The web interfaces were created for data entering into MySQL Server. HyperText

Markup Language (HTML), PHP, Cascading Style Sheets (CSS) and JavaScript were used in designing most of the web pages. phpMyAdmin is also used to connect the TOHAP database in order to manipulate the MySQL Server.

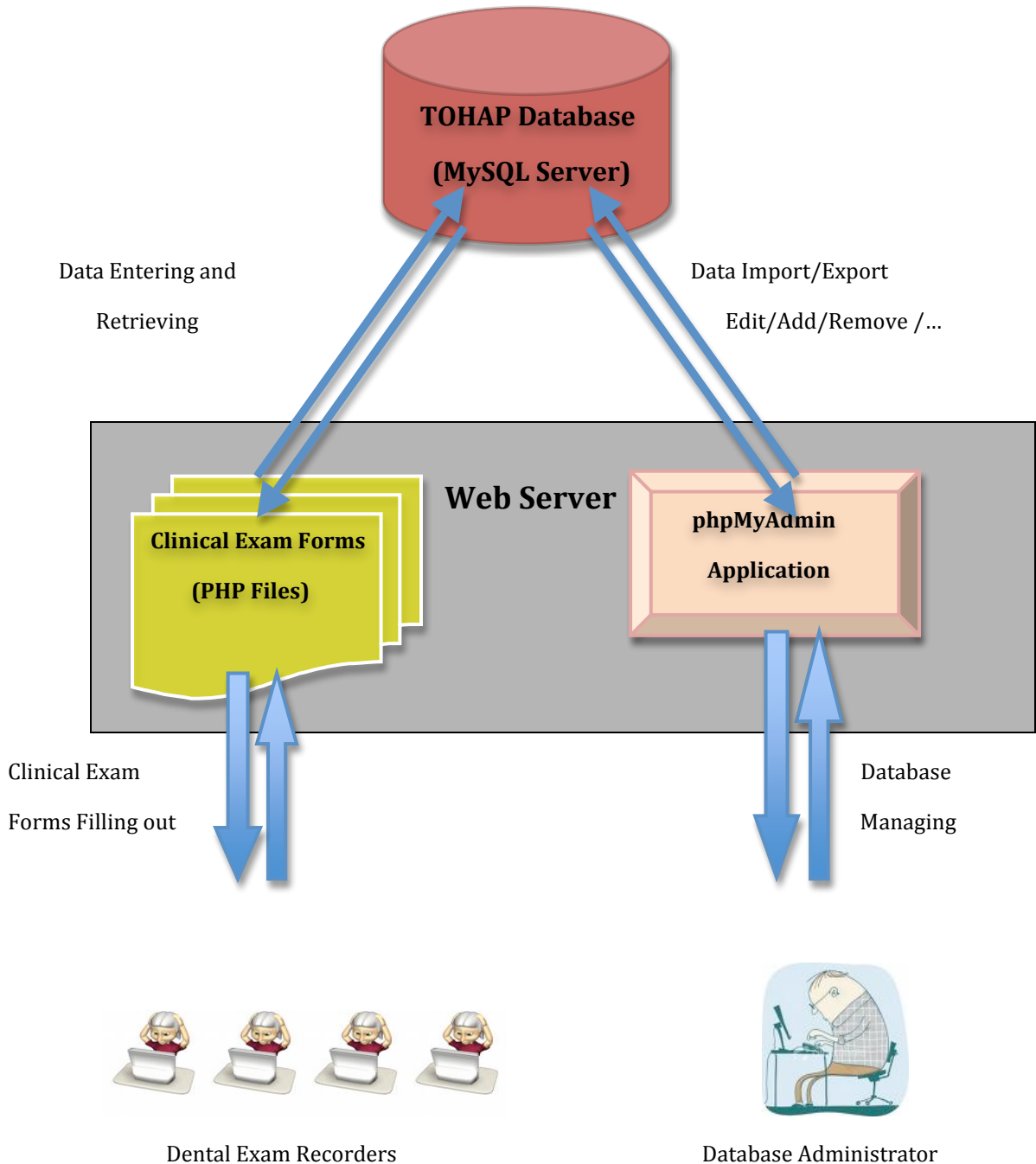
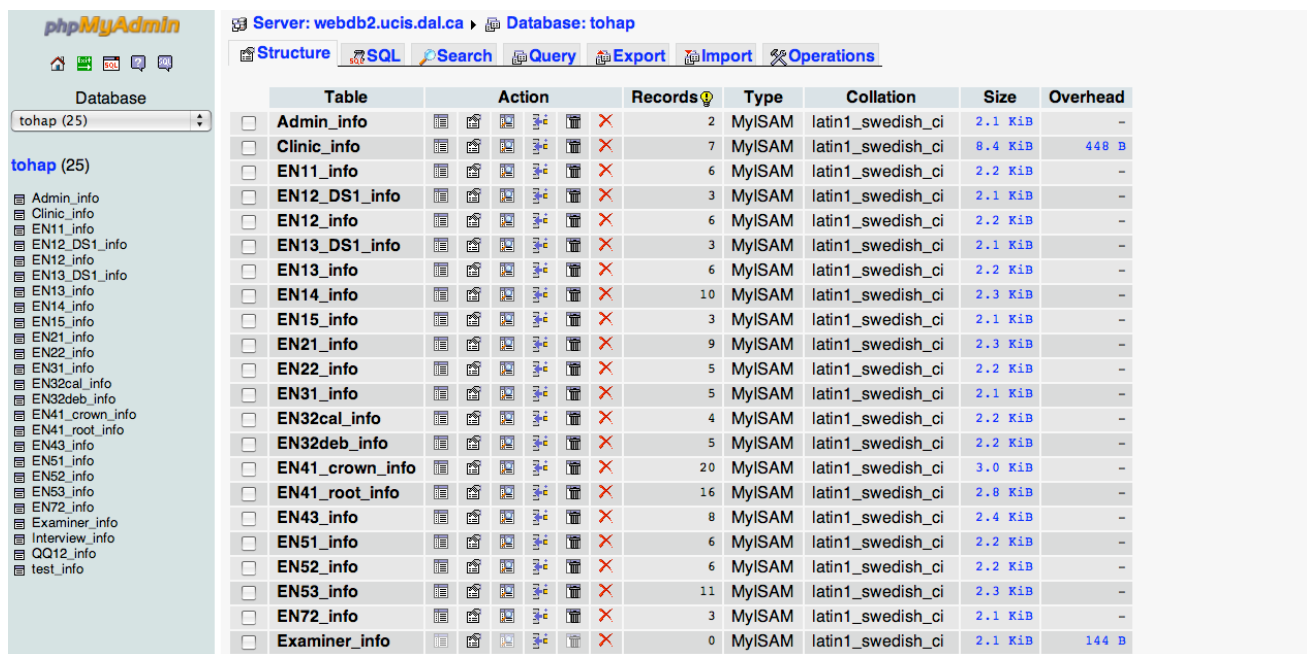


Figure 1: Overview of the TOHAP Database architecture

6-1- MySQL Database Server

The MySQL software delivers a very fast, multi-threaded, multi-user, and robust Structured Query Language (SQL) database server. The MySQL database server is intended for mission-critical, heavy-load production systems as well as for embedding into mass-deployed software (11) In the TOHAP database design, the MySQL database server is made up 25 tables. Figure 2 shows the tables existing in MySQL server.



The screenshot shows the phpMyAdmin interface for the 'tohap' database. The left sidebar lists 25 tables: Admin_info, Clinic_info, EN11_info, EN12_DS1_info, EN12_info, EN13_DS1_info, EN13_info, EN14_info, EN15_info, EN21_info, EN22_info, EN31_info, EN32cal_info, EN32deb_info, EN41_crown_info, EN41_root_info, EN43_info, EN51_info, EN52_info, EN53_info, EN72_info, Examiner_info, Interview_info, QQ12_info, and test_info. The main area displays a table structure view with columns: Table, Action, Records, Type, Collation, Size, and Overhead. The data is as follows:

Table	Action	Records	Type	Collation	Size	Overhead
Admin_info	[Icons]	2	MyISAM	latin1_swedish_ci	2.1 KiB	-
Clinic_info	[Icons]	7	MyISAM	latin1_swedish_ci	8.4 KiB	448 B
EN11_info	[Icons]	6	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN12_DS1_info	[Icons]	3	MyISAM	latin1_swedish_ci	2.1 KiB	-
EN12_info	[Icons]	6	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN13_DS1_info	[Icons]	3	MyISAM	latin1_swedish_ci	2.1 KiB	-
EN13_info	[Icons]	6	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN14_info	[Icons]	10	MyISAM	latin1_swedish_ci	2.3 KiB	-
EN15_info	[Icons]	3	MyISAM	latin1_swedish_ci	2.1 KiB	-
EN21_info	[Icons]	9	MyISAM	latin1_swedish_ci	2.3 KiB	-
EN22_info	[Icons]	5	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN31_info	[Icons]	5	MyISAM	latin1_swedish_ci	2.1 KiB	-
EN32cal_info	[Icons]	4	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN32deb_info	[Icons]	5	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN41_crown_info	[Icons]	20	MyISAM	latin1_swedish_ci	3.0 KiB	-
EN41_root_info	[Icons]	16	MyISAM	latin1_swedish_ci	2.8 KiB	-
EN43_info	[Icons]	8	MyISAM	latin1_swedish_ci	2.4 KiB	-
EN51_info	[Icons]	6	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN52_info	[Icons]	6	MyISAM	latin1_swedish_ci	2.2 KiB	-
EN53_info	[Icons]	11	MyISAM	latin1_swedish_ci	2.3 KiB	-
EN72_info	[Icons]	3	MyISAM	latin1_swedish_ci	2.1 KiB	-
Examiner_info	[Icons]	0	MyISAM	latin1_swedish_ci	2.1 KiB	144 B

Figure 2- TOHAP database showing the tables existing in MySQL server

6-2- phpMyAdmin

phpMyAdmin is a tool written in PHP which is intended to handle the administration of a MySQL database over the Web. Currently it can create and drop databases, create/drop/alter tables, delete/edit/add fields, import/export data, execute any SQL statement and manage keys on fields.

The administrator can access the phpMyAdmin login page (Fig. 3) at the following URL:

<http://TOHAP.dentistry.dal.ca/database/phpmyadmin/index.php>

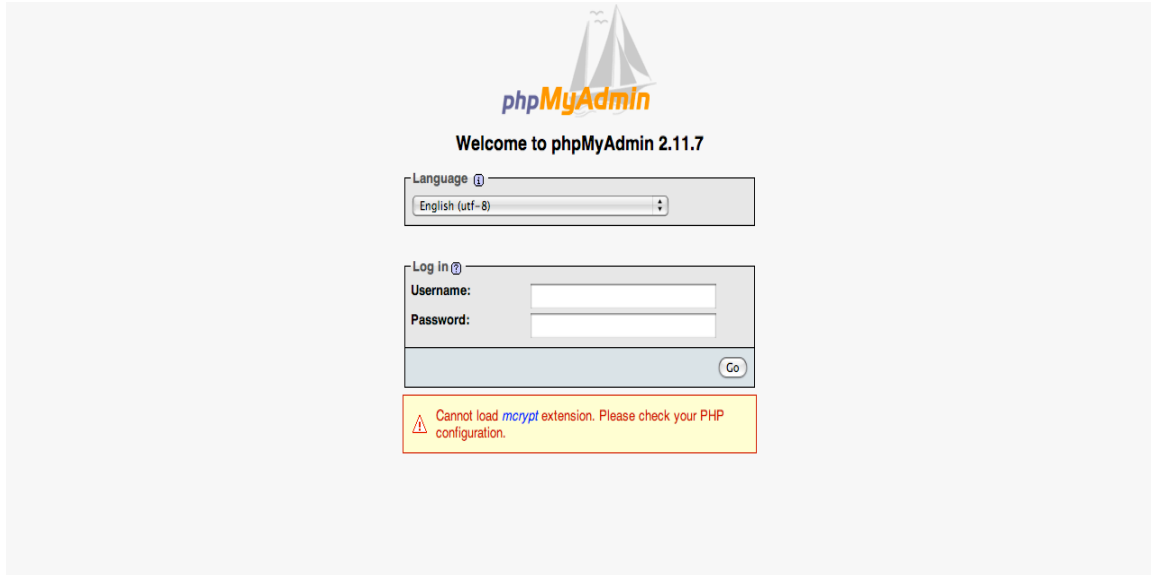


Figure 3- phpMyAdmin login page

6-3- Web Interface (Clinical Exam Questionnaire)

The clinical exam login page is accessible at:

http://TOHAP.dentistry.dal.ca/database/TOHAP_login.php

Users can login with a username and password that has been provided previously (Fig.4).

Once the username and password are verified, the user can access the TOHAP index page (Fig.5).

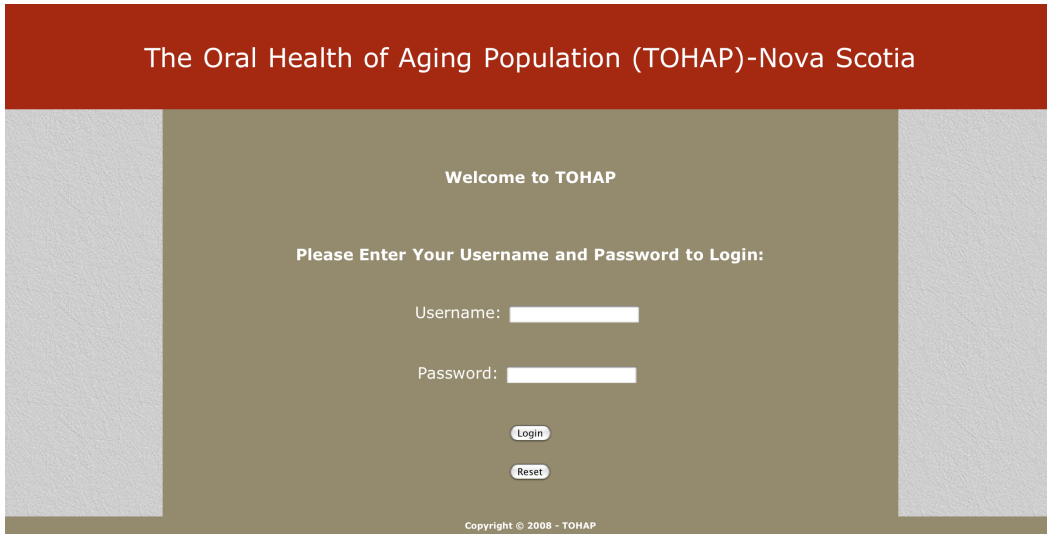


Figure 4- The TOHAP clinical examination form-login page

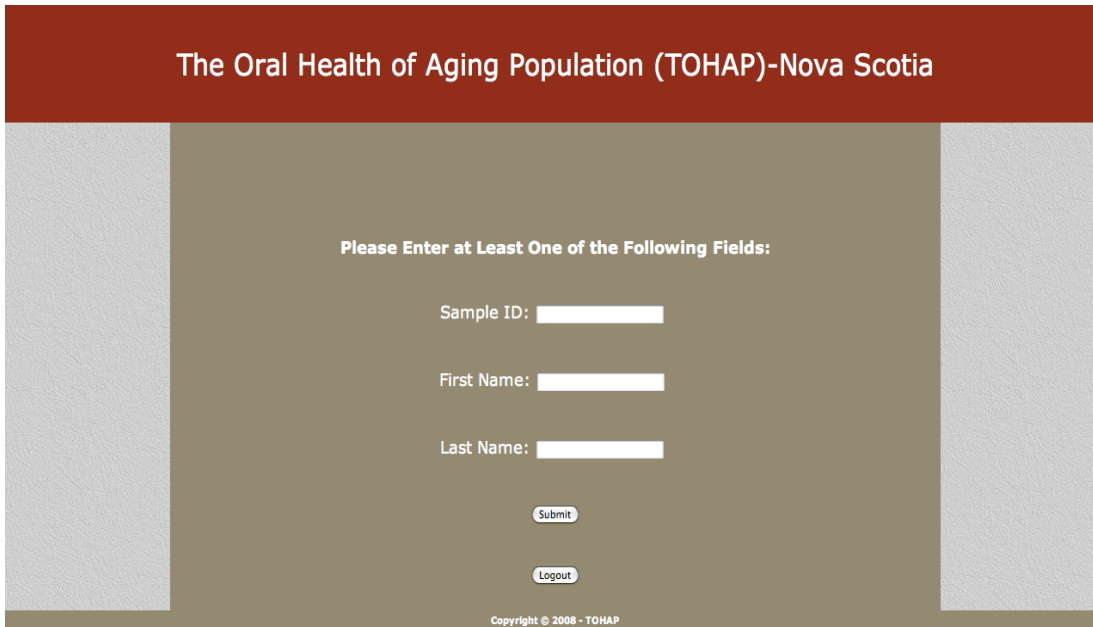


Figure 5- The TOHAP clinical examination form-index page

Prior to starting the clinical examination all of the samples in the TOHAP study will have been interviewed via telephone by a marketing company. For each sample a six-digit ID

will have been assigned. At the index page users are asked to send a query to the telephone interview database in order to gain some required information. This query must contain at least one of the following pieces of information: sample ID, first name or last name.

Once the query is submitted, the telephone interview database will send back a list of individuals who match the information provided. The list will include ID, first name, last name, telephone number and age (Fig. 6). The user then needs to select the correct individual from the list by clicking on his/her ID. By recording the sample ID at the beginning of the clinical exam, the link between the two different components of the study (i.e. the telephone interview and the clinical examination) will be established.

The Oral Health of Aging Population (TOHAP)-Nova Scotia

Your search yielded the following result(s):

Sample ID	First Name	Last Name	Tel. Number	Age
1112	Maria	Shepherd	234-4755	56
1134	David	Graven		68
1111	John	Smith	429-4947	55
1141	Andrew	Asemotha	345-2983	46

Please fill out all requested information below.
Please select and click on a sample ID from the table above.

Sample ID

Examiner ID

Visit Date

Stand

Session

Copyright © 2008 - TOHAP

Figure 6-The TOHAP clinical examination insert-form page

The clinical questionnaire consists of various form features such as text fields, text areas, drop down menus, checkboxes and radio buttons. In order to decrease the time required to fill out the questionnaire and to decrease human error while entering data into the form, the clinical questionnaire form has been designed as an interactive form. For example, once the user selects some options in a question, based on the data that he/she has entered, some other options within that or other questions will be disabled (grayed out) - in which case the user will not be permitted to choose those options. Also sometimes pop-up windows will alert the user when he/she is not allowed to choose some options or if he/she skips mandatory questions to answer. It is very important that all questions are answered in the correct sequence; otherwise it may harm the data in the TOHAP database.

The clinical questionnaire contains 11 sections (blocks) including 214 attributes need to be filled out for each sample. The blocks are displayed in sequence once the user clicks on the “confirm/next block” button located at the left bottom of each block (Fig. 7). It is crucial that the user makes sure that all data provided within the block is accurate prior to clicking on the “confirm/next block” button. Although the user may be able to change data in previous blocks after confirming the current block, doing so may harm some data in the TOHAP database. If for any reason during the clinical examination the user wishes to leave the examination of the current sample incomplete (without recording it in the TOHAP database), he/she can hit the “Cancel” link located at the right bottom of the blocks (Fig. 6). The user can then decide either to examine a new sample or to logout from the website.

After completing all of the blocks the user needs to hit the “submit” button in order to send the sample clinical information to the TOHAP database. Once the form is submitted, the user should receive a message indicating that the clinical information of the current sample has been successfully inserted into the TOHAP database (Fig. 8). On the same page, the user will see some statistics about the number of samples already existing in the TOHAP database and the time he/she has spent on the clinical examination of the current sample.

The screenshot shows a digital questionnaire form with a dark olive green background. At the top, there are four checkboxes: 'Anterior open bite (> 1 mm)' (unchecked), 'Excessive overbite (100% or more)' (checked), 'Excessive overjet (> 9 mm)' (checked), and 'Midline shift (> 4 mm)' (checked). Below this is a section for 'OHE_N22-Record the current orthodontic treatment status of the respondent.' with four options: 'No orthodontic treatment' (checked), 'Removable appliances' (unchecked), 'Fixed appliances' (unchecked), 'Both fixed and removable appliances' (unchecked), and 'Retainer _ post completion' (unchecked). The next section is 'OHE_N23-Record whether the respondent has received orthodontic treatment in the past.' with two radio buttons: 'Yes' (selected) and 'No' (unselected). A 'Confirm/Next Block' button is centered below. The 'Periodontal Assessments' section is titled 'OHE_N31-"Gingival Score"-Record the worst status for each tooth.' and contains six dropdown menus for teeth 16, 12, 24, 36, 32, and 44. The selected values are: Tooth 16: Moderate inflammation; Tooth 12: No inflammation; Tooth 24: Severe inflammation; Tooth 36: Tooth missing; Tooth 32: Mild inflammation; Tooth 44: Select.

Figure 7- The TOHAP clinical exam questionnaire

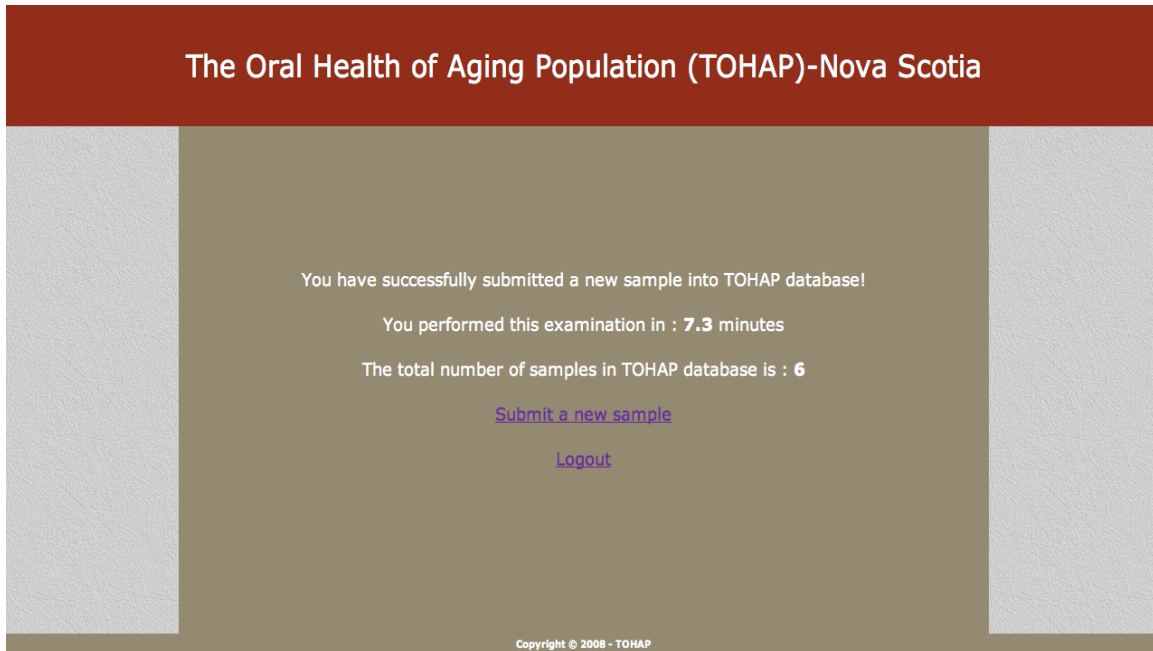


Figure 8-The TOHAP clinical exam questionnaire, successful submission message

After all clinical examinations are completed, the data must be exported from the TOHAP database for statistical analysis. This process can be performed through phpMyAdmin application.

7- Conclusion

Health Informatics is the rapidly developing scientific field that utilizes computer technology in the advancement of health care. Health Informatics can facilitate the flow of health information, and the main internship objective involved some extent of information flow.

In the internship it is investigated how health data are collected, stored and communicated; how those vast quantities of data are processed into health information

suitable for statistical analysis and health policy making; and how computer and technology can be applied to support these processes.

8- Recommendation

The implementation of the TOHAP database in the MySQL server provides great and enormous potential that would support various functions in the near future. These functions include:

- Generalize the TOHAP survey to the other provinces across the country or even intercontinentally or internationally
- Incorporate personalized delivery of patient information: To allow patients to view their oral health status information as well as their treatment needs online
- Patient education and empowerment: To provide educational materials on specific topic of interest for the patient to make informed decisions
- Online patient data entry in the format of web-based surveys
- Extract patterns of interest using data mining algorithms

References:

- (1) Petersen PE. *The World Oral Health Report 2003: continuous improvement of oral health in the 21st century--the approach of the WHO Global Oral Health Programme. Community Dent.Oral Epidemiol. 2003 Dec;31 Suppl 1:3-23.*
- (2) Johnson NW, Glick M, Mbuguye TN. (A2) *Oral health and general health. Adv.Dent.Res. 2006 Apr 1;19(1):118-121.*
- (3) Gift HC, Atchison KA. *Oral health, health, and health-related quality of life. Med.Care 1995 Nov;33(11 Suppl):NS57-77.*
- (4) Keller HH, Ostbye T, Goy R. *Nutritional risk predicts quality of life in elderly community-living Canadians. J.Gerontol.A Biol.Sci.Med.Sci. 2004 Jan;59(1):68-74.*
- (5) Collin HL, Uusitupa M, Niskanen L, Kontturi-Narhi V, Markkanen H, Koivisto AM, et al. *Periodontal findings in elderly patients with non-insulin dependent diabetes mellitus. J.Periodontol. 1998 Sep;69(9):962-966.*
- (6) Sandberg GE, Sundberg HE, Fjellstrom CA, Wikblad KF. *Type 2 diabetes and oral health A comparison between diabetic and non-diabetic subjects. Diabetes Res.Clin.Pract. 2000;50(1):27-34.*
- (7) Wu T, Trevisan M, Genco RJ, Falkner KL, Dorn JP, Sempos CT. *Examination of the relation between periodontal health status and cardiovascular risk factors: serum total and high density lipoprotein cholesterol, C-reactive protein, and plasma fibrinogen. Am.J.Epidemiol. 2000 Feb 1;151(3):273-282.*
- (8) Albandar JM, Brunelle JA, Kingman A. *Destructive periodontal disease in adults 30 years of age and older in the United States, 1988-1994. J.Periodontol. 1999 Jan;70(1):13-29.*
- (9) MacEntee MI, Scully C. *Oral disorders and treatment implications in people over 75 years. Community Dent.Oral Epidemiol. 1988 Oct;16(5):271-273.*
- (10) Galan D, Brex M, Heath MR. *Oral health status of a population of community-dwelling older Canadians. Gerodontology 1995 Jul;12(1):41-48.*
- (11) MySQL, "MySQL Manual: General Information." [<http://dev.mysql.com/doc/mysql/en/Introduction.html>]. 21 Aug 2004.