



Faculty of Information and Communication Technology

**A COMPLETENESS EVALUATION OF PATIENT RECORDS
IN MEDICAL TOURISM USING COMPLETENESS
EVALUATION TOOL**

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**Master of Computer Science in Database
Technology**

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**A COMPLETENESS EVALUATION OF PATIENT RECORDS IN MEDICAL TOURISM
USING COMPLETENESS EVALUATION TOOL**

NOR RABBIATUN BINTI MOHAMED NAZRI

**A thesis submitted
in fulfillment of the requirements for the degree of Master of Computer Science
in Database Technology**

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DECLARATION

I declare that this thesis entitled “A Completeness Evaluation of Patient Records in Medical Tourism Using Completeness Evaluation Tool” is the result of my own research except as cited in the references. This thesis has not been accepted for any degree and is not currently submitted in the candidature of any other degree.

Signature:

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Date : 18 August 2014

APPROVAL

I hereby declare that I have read through this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Computer Science in Database Technology.

Signature :

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Date : 18 August 2014

DEDICATION

*I specially dedicate this thesis to my beloved parents,
“Mohamed Nazri bin Mohd Lasa” and “Mahani binti Toroh”,
who supported me throughout my study and who always prays for my success.*

*Dedication to my lovely siblings especially to my sisters,
“Mardinatun”, “Maizatun” and “Halimatun”,
Who always believe in every decision I made and
who have always supported me in so many ways throughout my study.*

*Dedication to “Sofian Sury bin Jamil”,
who has faith in me and
who has always staying with me,
despite all the pressure and stress I put him through during my study.*

ABSTRACT

Medical tourism is a new and fresh industry that is not fully explored by researchers. In fact, there are too few medical tourism data due to the lack of exploration in this area. In recent years, it is shown that medical tourism industry is blooming. People travel worldwide in order to find cheaper, available and accessible medical treatments. However, when people travel a lot from one place to another for medical treatments, some of their medical records went missing or incomplete. Due to lack of tuple-based completeness evaluation tool in medical tourism, the completeness of patients' medical records in hospital databases are unknown. This study aims to investigate data completeness issues in medical tourism. This study also proposes a prototype that able to evaluate tuple-based completeness of patients' medical records. This study will involve two important phases which are investigation and implementation phase. In investigation phase, various literatures regarding data completeness issues in database are reviewed. In implementation phase, the prototype is developed to evaluate tuple-based completeness. In this study, diabetes patient records from 1999 until 2008 of clinical care at 130 United State hospitals were collected. A prototype is developed by using object-oriented and PL/SQL programming. The method used to evaluate tuple-based completeness is aggregate measure. This prototype is able to evaluate tuple-based completeness of patients' medical record. To justify the results generated from tuple-based completeness evaluation, the prototype also evaluate null-based completeness. An experiment is conducted based on three cases using three different patients' medical records which are Patient X, Y and Z. From the experiment, the completeness of patients' medical records for each Patient X, Y and Z are known. As a conclusion, data completeness issues of patients' medical records in medical tourism are explored and the prototype is able to evaluate both tuple-based and null-based completeness of patients' medical records.

ABSTRAK

Pelancongan perubatan adalah industri baru dan segar yang tidak diterokai sepenuhnya oleh penyelidik. Sebenarnya, terdapat terlalu sedikit data pelancongan perubatan kerana kekurangan penerokaan dalam kajian ini. Sejak kebelakangan ini, ia menunjukkan bahawa industri pelancongan perubatan semakin mendapat sambutan. Pelancong melancong ke seluruh dunia untuk mencari perkhidmatan kesihatan yang lebih murah, yang senang didapati dan mempunyai akses rawatan perubatan. Walau bagaimanapun, apabila pelancong banyak bergerak dari satu tempat ke tempat lain untuk rawatan perubatan, beberapa rekod perubatan mereka hilang atau tidak lengkap. Disebabkan kekurangan alat untuk menilai kelengkapan berdasarkan tuple rekod perubatan pesakit, maklumat mengenai kelengkapan rekod perubatan pelancong dalam pangkalan data sesuatu hospital tidak dapat diketahui. Matlamat kajian ini adalah untuk mengkaji isu-isu berkaitan kelengkapan data dalam pelancongan perubatan. Kajian ini juga mencadangkan satu prototaip yang boleh menilai kelengkapan data berdasarkan tuple rekod perubatan pesakit. Kajian ini melibatkan dua fasa penting iaitu fasa penyiasatan dan pelaksanaan. Dalam fasa penyiasatan, pelbagai kajian mengenai isu-isu data yang lengkap dalam pangkalan data dikaji. Dalam fasa pelaksanaan, prototaip dibangunkan untuk membuat penilaian kelengkapan berdasarkan tuple rekod perubatan pesakit dalam pangkalan data hospital. Dalam kajian ini, rekod pesakit kencing manis dari tahun 1999 hingga 2008 di 130 hospital di sekitar Amerika Syarikat dikumpulkan. Prototaip ini dibangunkan dengan menggunakan pengaturcaraan berorientasikan objek dan pengaturcaraan PL/SQL. Kaedah yang digunakan untuk menilai kelengkapan berdasarkan tuple rekod perubatan pesakit adalah menggunakan kaedah agregat. Prototaip ini boleh menilai kelengkapan data berdasarkan tuple rekod perubatan pesakit. Untuk menyokong keputusan yang dihasilkan daripada penilaian kelengkapan berdasarkan tuple rekod perubatan pesakit, prototaip juga menilai kelengkapan berdasarkan maklumat yang hilang dalam rekod pesakit. Eksperimen dijalankan berdasarkan tiga kes menggunakan rekod perubatan pesakit yang berbeza-beza iaitu Pesakit X, Y dan Z. Daripada eksperimen itu, kelengkapan rekod perubatan pesakit untuk ketiga-tiga Pesakit X, Y dan Z dapat diketahui. Konklusinya, isu-isu mengenai kelengkapan data rekod perubatan pesakit dalam pelancongan perubatan telah dikaji dan prototaip dapat menilai kedua-dua kelengkapan data berdasarkan tuple rekod perubatan pesakit dan kelengkapan berdasarkan maklumat yang hilang dalam rekod perubatan pesakit.

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LIST OF ABBREVIATIONS

ACS	-	American College Surgeons
GUI	-	Graphical User Interface
MT	-	Medical Tourist
NBC	-	Null-Based Completeness
OOP	-	Object Oriented Programming
PL/SQL	-	Procedural Language/Structured Query Language
SQL	-	Structured Query Language
TBC	-	Tuple-Based Completeness

CHAPTER 1

INTRODUCTION

Medical tourism industry has grown rapidly in the past decade. People tends to travel either locally or abroad for medical treatments that are available and cheap which otherwise might be unavailable or expensive in some places. In medical tourism environment, when people travels, they requires a complete medical records of their past treatments. Thus, completeness of patients' medical records is one of the prominent concern in this industry. Ideally, any doctors who treat a patient should be able to obtain the patient's complete medical records regardless of the location of clinics or hospitals where the treatment is provided (locally or abroad). Medical records consists of important information of patient regarding patient's past treatments, allergies and other basic information which are crucial for doctors to diagnose certain disease before providing suitable treatments and prescriptions. However, due to incomplete medical records, patients are usually required to undergo similar and tedious medical procedures each time they are admitted for treatment. In addition, the repeated medical procedures are also time-consuming and painful experience for the patient.

1.1 Background of Study

Medical tourism is a branch of healthcare services that focuses on patients who travel abroad for medical treatments. Medical treatments include cosmetic enhancements, dental treatments and other type of surgeries (Connell, 2006)(Cormany & Baloglu, 2011). People tend to get medical treatments abroad because of lower medical costs, specialty treatments, privacy, and expedited medical attention provided by the foreign country (Cormany & Baloglu, 2011). The main issue in medical tourism is the quality of the patients' medical

records which need to be given full attention by the healthcare providers in order to improve and maintain their overall services (Mphatswe & Mate, 2012).

Data quality has become increasingly important in the healthcare field where cost pressures and the desire to improve patient care drive efforts to integrate and clean organizational data. Administrative data can contain inaccurate and unstable data, but they are readily available, relatively inexpensive and are widely used (Silva-Costa, 2010). In this research, one of data quality concern is data completeness. Data completeness which also referred to as data availability is the degree to which data values are present in the attributes that require them. Data completeness is typically described in terms of percentages or number of data values (Ahn et al., 2008).

In this research, it concerns on the completeness of medical tourism patients' medical records. It focuses on patients whose complete records of either their past treatments or the current medical records which are highly crucial. Ideally, any doctors who treat a patient should be able to obtain the patient's complete medical records regardless of the location of clinics or hospitals where the treatment is provided (locally or abroad). However, the reality is, the ideal scenarios can be rarely observed in healthcare systems today.

1.2 Problem Statement

Medical tourism is a new area that has not yet been fully explored by many researchers. The information regarding this domain is still vague. Researchers from many backgrounds tries to explore on factors, trends and consequences of medical tourism towards an individual as a medical tourist and also towards the economic growth of some countries that relies on medical tourism services. However, completeness issues of medical records in medical tourism are neglected. It may be due to lack of research information or data in this particular area.

In medical tourism, patients can seek medical treatments from different hospitals from time to time as desired. When a patient is treated at different hospitals, the medical records of the patient are scattered. Within a long period of time, the patient may be unable to track all of

his/her previous visits. The patient tends to forget which hospital he/she had visited and what type of treatments that he/she had during the visit. A complete medical records of the patient is unknown. Thus, due to incomplete medical records, patients are usually required to undergo the similar and tedious medical procedures each time they are admitted for treatment. The repeated medical procedures are also time-consuming and painful experience for the patient. Due to lack of tuple-based completeness evaluation tool developed or proposed in medical tourism, the knowledge on completeness of medical records in hospital databases are limited.

1.3 Research Question

Based on the problem statements as stated in an earlier section, the research questions of this study are as follows:

- a. What are the issues of data completeness of medical records in medical tourism?
- b. How to evaluate the tuple-based completeness of patients' medical records in medical tourism?

1.4 Research Objective

Research objectives of this study are described as follows:

1. To investigate the data completeness issues of medical records in medical tourism.
2. To propose a prototype that is able to evaluate the tuple-based completeness of patients' medical records.

1.5 Research Scope

The scopes of this study are;

- i. This study will use diabetes patients' medical records from 130 hospitals in United States as test data set to be evaluated in experiment process. The records consist of patients' demographic information such as patient number, race, weight and patients' health information such as list of medications.

- ii. This study will solely focus on the evaluation of tuple-based completeness in medical records. However, to support the result generated from the evaluation process of tuple-based completeness, the evaluation of null-based completeness is taken into account. The evaluation of null-based completeness solely acts as an aid to justify the result generated from tuple-based completeness evaluation.

1.6 Significant Contribution

The benefits of this research are not necessarily solely applicable in medical tourism. The proposed prototype can be implemented in other domains such as in education. However, the main goal of the research is to aid in the improvement of the medical data completeness in the industry. From the study, a prototype is developed. The prototype is developed to help in evaluation of data completeness specifically on tuple-based completeness. The prototype will be able to help doctors to monitor the completeness of patients' records in several hospital databases. The prototype is expected to assist Database Administrator and end-user such as doctors, to evaluate data completeness in medical records.

1.7 Organization of Thesis

This thesis consists of five chapters and structured as follows:

i. Chapter 1: Introduction

Chapter 1 is the introductory of this study. This chapter provides information about the domain of the study which is medical tourism. In introduction chapter, the main points explain regarding a brief overview of background study, problem definition, research question, the objectives of the study, limitation and scope of the study focusing on, significant contribution and summary.

ii. Chapter 2: Literature Review

Chapter 2 mainly focuses on the literature review. It presents brief introduction of current trends in medical tourism such as the factors and implication of medical tourism could bring to medical patient. This chapter also reviews data completeness issues in medical tourism from several literatures. This chapter will enlighten on medical tourism and data completeness as the global topic, and then the study focuses on the method to evaluate data completeness. Particularly, the review focuses on the standard measurement of data completeness evaluation proposed by many researchers.

iii. Chapter 3: Research Methodology

Chapter 3 is discusses on the research methodologies that used in this study in order to achieve the research objectives. It comprises an introduction, type of research method, research design, data collection and proposed framework and research tools used for experiment.

iv. Chapter 4: Design and Implementation

Chapter 4 can be classified as a main task in this study. The processes of experiment during the study are discusses in details. The design and implementation of proposed prototype are presented.

v. Chapter 5: Results and Discussion

In Chapter 5, the results obtained from Chapter 4 are presented. This chapter includes the discussion of the result that corresponds to the research objectives.

vi. Chapter 6: Conclusion and Future Work

Chapter 6 summarizes the overall of this study. The summarization includes the answers of the research questions and the achievement of research objectives. This chapter also includes some suggestions for future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, several literatures both on medical tourism and completeness are reviewed. In order to study the evaluation of completeness, it is best to understand the meaning of completeness and to learn several types of completeness being proposed recently. This chapter is presented with several related works on completeness and recent methods used by research to evaluate completeness. This chapter begins with the introduction of medical tourism worldwide. A brief elaboration on current trends of medical tourism is presented. This chapter also provides the definitions of data completeness that are extracted from different literatures. It includes the introduction of data completeness in database community and different categories of data completeness such as null-based completeness and tuple-based completeness. This chapter furthers the reviews by focusing on tuple-based completeness. Prior to the main objective of this study which is to evaluate data completeness, several measurements of data completeness used by exiting studies are reviewed.

2.2 Medical Tourism

Medical tourism is said to have grown explosively since the late 1990s with thousands of patients moving to countries such as India, Thailand and Mexico, in search of medical care usually deemed too expensive, inadequate or unavailable at home (Connell, 2013). There are statistical evidences that medical tourism have grown since the late 1990s up until recent years. For example, according to Helble, it is reported that Malaysia received 360000 foreign patients from the Association of Southeast Asian Nations (ASEAN) region in 2007. While in Thailand, the number of foreign patients more than doubled in five years, from around 630000 in 2002 to 1 373 000 in 2007.

In addition, according to a study by the World Health Organization (WHO) Regional Office for the Eastern Mediterranean, each year in Jordan more than 120 000 non-Jordanian patients are treated, generating an estimated US\$ 1 billion in annual revenue (Helble, 2011). It shows people tend to travel or move around the world to seek for better and cheaper medical treatments. There are various factors that encourage medical tourism such as affordability of the services, availability of the medical treatments at the clinics/hospitals, the quality of care from healthcare being attended, accessibility and other additional benefits (Stephano, 2012). Some delays in obtaining access to care in local healthcare facilities prompt patients to travel to regions where they can receive immediate treatment. For example, some patients wait-listed for treatment in Canada and the UK fly to India and arrange prompt access to hip and knee replacements (Turner, 2011). While, in other countries, the high cost of local healthcare is a major factor in prompting patients to seek treatment elsewhere. In the USA, over 47 million Americans lack health insurance (MacReady, 2007). These individuals, along with ‘underinsured’ Americans, often cannot obtain affordable care at local hospitals and clinics (Milstein et al., 2006). To find affordable care they must travel to such countries as Mexico and India.

In 2006, J Connell (2006) found out that some of the factors that encourage people to travel abroad for medical treatments include medical cost, skills and technologies provided, long-listed for treatment. John Cornell specified people who travel abroad for medical treatments as medical tourists (MT). Later, John Connell (2013) discovered that language is also one of the important factors that encourage medical tourism. This is because MT tend to travel to countries that they are comfortable with either by language, ethics or even food. MT choose to go to countries in the same language area, or where English is spoken, and in similar cultural contexts which in some circumstances include religious similarity.

Meanwhile, Jagyasi in his article from Medical Tourism Magazine (Jagyasi, 2008) summarized the factors of medical tourism into 5’A factors which is Affordable, Available, Accessible, Acceptable and Additional. Each of the key points of the factors written by Jagyasi helps in explaining the factors of MT to travel abroad for medical treatments. The brief explanation regarding the 5’A factors are described in Table 2.1.