EFFECTIVE ONLINE RETRIEVAL SYSTEM
FOR
MEDICAL SERVICE PROVIDER INFORMATION

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บทความนี้วิเคราะห์เว็บไซต์การท่องเที่ยวเชิงการแพทย์ที่ใช้งานอยู่ในปัจจุบันและกล่าวถึงความพร้อมใช้งานของคุณลักษณะต่างๆในเว็บไซต์เหล่านี้ การวิเคราะห์จะขึ้นอยู่กับข้อมูลที่เก็บรวบรวมเกี่ยวกับความสำคัญและรูปแบบการค้นหาออนไลน์ของผู้ใช้จากคนเหล่านั้นที่มีประสบการณ์ด้านการท่องเที่ยวทางการแพทย์และการค้นหาข้อมูลทางการแพทย์บนอินเทอร์เน็ต การศึกษาครั้งนี้มุ่งเน้นไปที่ตลาดการท่องเที่ยวเชิงการแพทย์ในประเทศไทยเนื่องจากความนิยมและการจัดอันดับสูงในหมู่จุดหมายการท่องเที่ยวทางการแพทย์ต่างประเทศอื่น ๆ ระบบการรวมการท่องเที่ยวทางการแพทย์เสนอโดยใช้เครื่องมือการทำเหมืองข้อมูล - กฎของสมาคม การประเมินระบบได้แสดงให้เห็นว่าระบบที่เสนอนี้ช่วยเพิ่มความเร็วในการประมวลผลข้อมูลของผู้ใช้และลดเวลาในการตัดสินใจของผู้ใช้

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This paper analyzes the current active Medical Tourism websites and discusses the availability of various features among these websites. The analysis is based on the collected data about the features' importance and users' online search patterns from those people have experiences in Medical Tourism and medical information search on the Internet. This study focuses on the medical tourism market in Thailand due to its popularity and high ranking among other international medical tourism destinations. A medical tourism aggregative system is proposed by using one of the Data Mining tools – Association rule. The system evaluation showed the proposed system can improve users' information processing speed and reduce users' decision making time.

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CHAPTER I – INTRODUCTION

1.1 Background

Medical Tourism websites provide valuable information to people looking for medical treatments outside their countries of residence. However, seeking specific information about medical service providers' accreditation (certificate), doctors' qualifications, other patients' reviews, treatment costs, other involved costs (e.g. travel cost and insurance) and support information (pre-, during, and post-treatment) is time-consuming for users. Furthermore, different types of users need different types of information. Therefore, it is necessary for any website to customize its information to fit the needs of users within the shortest time possible. A well customized Medical Tourism website can boost up the success of Medical Tourism in the long run both at the level of the particular medical institution and overall for the country. A unique system needs to be developed to direct users to the most important sets of data for them as well as to use specific tools to improve user interface for making their decision at the very early phase of search for a potential medical provider.

The Association Rule technique in data mining is a suitable tool to be applied in this case. The goal of using the Association Rule in any information retrieval system is to effectively identify two kinds of relationships - the relationship between users and website features (data tags), and the relationship among all website data tags. However, without data about the kinds of services provided by active Medical Tourism websites and the information needed by potential customers visiting the websites, it is difficult to build a system that can fulfill this market gap. This paper surveyed and collected data of data tags available in several Medical Tourism websites, several new applications, and previously proposed systems to further analyze the surveyed data. A feasible framework for the user interface was proposed to improve site navigation and information retrieval in order to achieve optimal user's experience as well as provide an analytical graph to help the user make a better decision.

1.2 Motivation

The reason for choosing Thailand as the target area for this research is due to a combination of perceived lower costs coupled with highly trained medical staff, highly developed private medical infrastructure, and its top ranking among destinations for Medical Tourism annually growing by about 20% [1, 2]. Medical Tourism and information technology are closely related because when people consider undergoing any medical treatment overseas, their first source for seeking information is the Internet. There are many Medical Tourism websites playing an important role in providing information to help people find the right hospital for their treatment aboard. Users could consider accessing a Medical Tourism website instead of a hospital website because the hospital website does not always provide patient reviews and comparative information with other hospitals. The search is time consuming for users needing to visit hospital websites one by one.

Furthermore, according to market analysis, none of the Medical Tourism websites provide any functions or tools to assist users in analyzing the information based on user's background and preferences. The system proposed in this paper attempts to minimize irrelevant information search and retrieval time. The system also proposes data tags to display statistical information in a graphic format to help users gain an overview of all options before making a decision.

1.3 Objective

Based on market analysis and research result showing the unsatisfactory data tags in existing active Medical Tourism websites, there is a lot of information on these websites without a clear direction to guide the users to go to relevant information. Rearrangement of data, interface modification, and application of data mining tool such as the Association Rule are necessary for a Medical Tourism website. The Association Rule could effectively improve the functionality of a Medical Tourism website by reducing the time of information search and provide a better visualization interface. The ultimate goal for this system is to reduce user's online information search time and to assist the user to make a better decision when treatment aboard is required.

1.4 Expected outcomes

The result of the survey would enhance the issues of user's online medical information search patterns, scale of importance of different data tags, and information searched on Internet which may not exist in any active Medical Tourism websites at this moment. Also, the research will prove additional analytical tools which are missing in all active Medical Tourism websites.

In system test and review the result should show the proposed system requires less search time than other current Medical tourism websites. The proposed system should also have better user interface and could direct users to reach the targeted information in the minimal time even those users which are first time uses of the proposed system. Also, users will give comments about the statistical information display location and visual format and at the end users should prefer the proposed system.

1.5 System requirements

The following components should be integrated as parts of a well-designed Medical Tourism website based on the survey of users' requirements.

1.5.1 Data management

Data management is an administrative process that requires a new system to handle different formats of data, such as Hospital accreditation in pdf format; Hospital profile and doctor profile in text format; Hospital profile in video format; statistical comparison of data in graph format. Also, it is important to manage different formats of information to display in multiple platforms, such as computer, tablet, and smartphone. A data management plan could keep everyone in the project on track of how to collect, store, describe the data, as well as how to share data with users.

1.5.2 Content management system (CMS)

The CMS is an application that provides capabilities for a developer or a web administrator with different permission levels to manage content, data, or information of a new website system. The proposed system will allow users to review the hospital facilities and quality of services. Everyone can see the reviews and comments but only the registered members are able to upload the comments published upon approval of the system administrator. The system will collect the data about the quality of service, the performance of doctors, and hospital staffs from users in a rating format. The administrator will upload these data on the website in a graphic format easy to understand by users. The price comparison data will be conducted by the administrator and also displayed in a graphic format. The response rate is recorded as the hospital response time once the user sends out the enquiry to a hospital via the proposed system.

The website not only must provide a clear and easily readable contents, but also needs to provide the most relevant content for users and allow users to retrieve this information easily within a reasonable time. However, each user will have a different scale of importance for different types of information needed. In this study, the marketing research will find users from different backgrounds and their scale of importance of different types of information as well as demand of data tags in the Medical Tourism website to be designed.

1.5.3 Data security

Sufficient security patches are necessary to protect user's personal data and medical history information (the communication between users and medical service provider will involve medical history in the content). The security system should act as a safeguard and enable to protect data from corruption, loss, and/or unauthorized access from hackers and illegal activities.

1.5.4 User management

For security reason, the system will only allow registered members to upload comments and contact hospital through the system. It could help system administrator identify and control user's activities on the website. The system administrator has the right to grant, hold, deny, and block any user. Also, the system administrator will collect the data of user IP address, log-in counts, and log-in times for system improvement and marketing purposes.

1.5.5 Process management

Process management is a method to make the works of system flow more effective and efficient and also adapt itself to changing environment factors. This method allows the system administrator to systematically control the process as well as make proper modifications on time when needed. In this proposed system, since the system must involve different display interfaces for different users, a proper process management is extremely important to give a smooth flow of information shortest time possible.

When a user logs in to the website system, it is important to control and track the user's preferences and traffic flows from each single individual user. The Association Rule in data mining is deployed to handle this task. The Association Rule could match a new user with similar background data (data sets) in database and recommend the most important information as well as data tags to the new user. For returning users, the Association Rule not only can adjust the location of displayed data tags according to user's previous visits, it also can recommend some potentially important data tags that users may not previously click.

1.5.6 Analytics

Analytics is an encompassing and multidimensional tool using mathematical method to analyze statistical data to predict the outcome. In this proposed system, the report section will analyze some data that important for users, such as hospital performance and quality, hospital response rate, and price comparison. These data can help the user make a better decision when choosing the right medical service provider for their treatment. The analytical results with up-to-date data about different hospital response rates, price comparison for the same treatment in different hospitals, and experience measurement from other users may decrease the web surfing time of the user.

1.5.7 Data retrieval

In order to reduce user information search time, the proposed system must set a series of criteria for the system to retrieve the most relevant information for users. The criteria of information extraction will depend on the survey result which may be used to predict any future user with the same background (same data set) and the information in priority location as it might be important to the user. The system should also be capable of learning from the user's searching information patterns and predicting what kinds of information are important for each particular user. The result of predicted new information is the first priority to be displayed when the user logins to the system next time.

1.6 Organization of the thesis

The rest of this thesis is organized as follows. Chapter 2 reviews the literature of similar systems. Chapter 3 summarizes the market analysis of system requirements for an optimal Medical Tourism website. Chapter 4 discusses the research methods used in this thesis. Chapter 5 reports the key finding. Chapter 6 explains the architecture of the proposed Medical Tourism aggregative system. Chapter 7 shows the application of the Association Rule in the proposed system. Chapter 8 describes the implementation and visual design of the proposed system. Chapter 9 provides the evaluation of the designed website and comments obtained from random foreigners residing in or visiting Bangkok area and were asked to test the system's functionality. Chapter 10 provides the thesis conclusions.

CHAPTER II - LITERATURE REVIEW

Not everyone trusts the information obtained on the Internet, especially information concerning medical treatments [3]. Some people still prefer to seek medical related information from their family, friends, and their doctors. Nowadays, the Internet is the most frequent used platform to conduct the first search for information [4]. Furthermore, when medical treatments are available and cheaper outside the country of residence, acquiring information through the Internet is the most convenient, efficient and practical method in terms of time and cost in search of alternative treatment destinations.

2.1 Right data tags for users

The majority of data tags on a Medical Tourism website provide an overview of the available options when users consider medical treatment abroad. Nowadays, searches for medical treatment aboard on the Internet are increasing. However, the massive size of information can be overwhelming [3, 4] for any user. Using metadata could make search results more complete [5]. Despite of that, not everyone knows how to generate the information from metadata. Furthermore, it is expensive for companies to use metadata in their system and users must spend a long time to filter results to obtain the needed information. Hypothetically, if there were tools able to automatically adjust the priorities of data tabs on the website displayed based on user's background information, this would help users save time to filter irrelevant information. Additionally, analytical graphs to review statistical data could also assist users in making their decision more efficiently and effectively and could help users determine which destination is the best fit for their requirements.

Medical Tourism websites (e.g. Medical Tourism facilitator – MTF) must display the right information [6]. However, the information demanded by users is constantly changing due to different backgrounds and scale of importance for different information. Some information is critical in search result pages[7] such as the cost for particular treatments, lists of available support services before/during/after treatment, medical service provider response time and response rate, etc. Without such information, the search results cannot be called reliable and useful.

Mobile applications (e.g. Google Maps) are useful tools while people travel abroad. The right application could help users reduce their levels of stress. Some Medical Tourism applications not only provide mapping and useful information for travelers, they also link users' social media accounts to applications [8]. However, having medical treatment aboard is different from holidays planning as users might not want to share their medical related travel information with their friends and/or family. Linking social media in Medical Tourism application may not be the right function for most users.

2.2 System availability

Shunsuke, Takasin, Takahiro, and Katsuhiko proposed a specialist search engine to guide users to extract relevant information from the overwhelming number of hospital websites. This can reduce users search time, especially search result providing reliable outcomes for users [9]. However, their proposed system is not available everywhere as only users inside a particular hospital could access the system. In this case, the system only benefits a few users who already experienced the services and treatments in the particular hospital. Users cannot benefit from this system if they are not in that particular hospital.

Although there are many Medical Tourism applications available to download, some are only available for one type of operating system, such as the Taiwan Medical Travel application [10]. This application targets only Mainland Chinese. The idea of this application is good but it is only available on iTunes while the majority of people in China are using Android. Most of the target population cannot benefit from this application if they do not have iPhones. In another case, one application is only available for Window phones [8]. In fact, IOS and Android are most common devices nowadays and this will have a big impact on application popularity and user coverage.

2.3 System tools review

Richa, Shailendra, and Sujata proposed to use of classification and clustering to develop medical related applications to extract useful information from databases [11]. Their paper explained one of the Data Mining tools which is the Association Rule that could be useful in web page user interface development, especially in information retrieval. Andrey and Ilya promoted the classification technique in web page development [12]. Truth classification technique could increase the accuracy of search result, but when users look for medical treatment aboard, the information that they require can be from very general (travel information, hospital list) to very specific (support service details, doctor review). In this case, it is needed to consider using another data mining tool such as the Association Rule to help users retrieve the information in a minimum time and obtain more accurate search results.

The search time, traffic overview, unique visitor numbers, and click rate are very important for the website development and website revenue. All of this information could help businesses gain a better understanding of their customers or their potential customers [13]. With this information, the web developer could analyze which information is most relevant and modify the analysis report to best fit the users. The analysis report in Medical Tourism website should cover the review of Hospital, review of Doctors, and review of Staff, and Hospital response rate.

CHAPTER III - MARKET ANALYSIS

Currently, if a user types “Medical Tourism” in Google search, about 15 domestic and international Medical Tourism websites are displayed in the top ten pages of the Google search result. Noticeably, all these top displayed websites include Thailand as one of the Medical Tourism destinations. The content of each website offers some aspects of Medical Tourism facilitation in Thailand. For example, from the following considered websites, the types of information appearing in each website are summarized in Table 1**.**

http://www.besthospitaladvisor.com/ (US)
http://www.treatmentabroad.com/ (UK)
https://www.imtj.com/ (UK)
http://www.medicaldepartures.com (Singapore)
http://www.medretreat.com/ (US)
http://www.healthbase.com/ (US)
http://www.medicaltourismco.com/ (US)
http://medtrava.com/ (US / India)
http://www.discovermedicaltourism.com/ (US)
http://www.patientsbeyondborders.com/ (US)
http://www.meditravels.org/ (UK)
http://thailandforvisitors.com/general/medical.html (Thailand)
http://www.mymedholiday.com/ (Thailand)
http://www.thaimedtour.com/ (Thailand)
http://thailandmedtourism.tourismthailand.org/ (Thailand)

Table 1 - Information available on Medical Tourism website.

Country	US	UK	UK	Singapore	US	US	US	US / India	US	US	UK	Thailand	Thailand	Thailand	Thailand
Domain Name / Information Type	Best hospital advisor	Treatment aboard	International medical travel journal	Medical departure	Med retreat	Health base	Medical tourism co	Med trava	Discover medical tourism	Patient beyond borders	Medi travels	Thailand for visitors	My med holiday	Thai med tour	Thailand med tourism
Treatment		✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Destination Travel Guide		✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓
Destination Hospital Listing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hospital Profile	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Doctor Listing						✓	✓	✓							
Review / Blog	✓	✓		✓		✓		✓		✓			✓		
News	✓	✓	✓		✓		✓				✓		✓	✓	
Travel Assistance (Accommodation, flight ticket etc)				✓					✓			✓			✓
Treatment Assistance (Finance, insurance etc)			✓	✓		✓		✓			✓				

Besides displaying information, some of these websites extend their services by providing additional data tags on their websites as shown in Table 2 to help users get information faster and make decision. There are four out of 15 websites that are currently providing these additional informative data tags. These four domains include:

(1) Best Hospital Advisor,
(2) Treatment Abroad,
(3) International Medical Journal, and
(4) Medical Departure.

The additional data tags that these four websites offer to their users include:

(1) In-page keyword search,
(2) Index filtering,
(3) Currency option, and
(4) Price comparison.

All these four websites have in-page keyword searches and index filtering for every tag. The Treatment Abroad and Medical Departure websites are able to provide a cost comparison for the same treatment in different countries.

Table 2 - Comparison of targeted website data tags.

	US	*UK*	*UK*	*Singapore*
Categories / Website Data tags	**Best hospital advisor**	**Treatment abroad**	**International medical travel journal**	**Medical departures**
In-page keyword search	✓	✓	✓	✓
Index filtering	✓	✓	✓	✓
Currency options		✓		✓
Price comparison		✓		✓

CHAPTER IV - RESEARCH METHODOLOGY

There were five steps that were undertaken prior to the analysis. The first step was to specify the target city. The second step was to estimate the sample size. The third step was the design of the questionnaire. The forth step was data collection. The last step was to set the criteria to eliminate and disqualify data. The details of each step are as follows:

4.1 Targeted city and population selection

The targeted geographic area chosen was Bangkok city, Thailand. The survey targeted foreigners undertaking medical treatments in Bangkok hospitals during the period between March and June of 2016. The foreigners were visiting Thailand or living in Thailand.

4.2 Sample size estimation

The samples size of the survey conducted for this paper was randomly selected and the collected data were from a portion of the targeted population. Sampling statistics was used to generalize the findings to represent the whole target population. Based on Kasikorn Bank report on the number of medical tourists in the year 2015 [14], the size of the Medical Tourism population was 2.81 million. The standard normal distribution was used to find out the proper sample size that could represent the target population. Figure 1 shows all the involved elements in standard normal distribution.

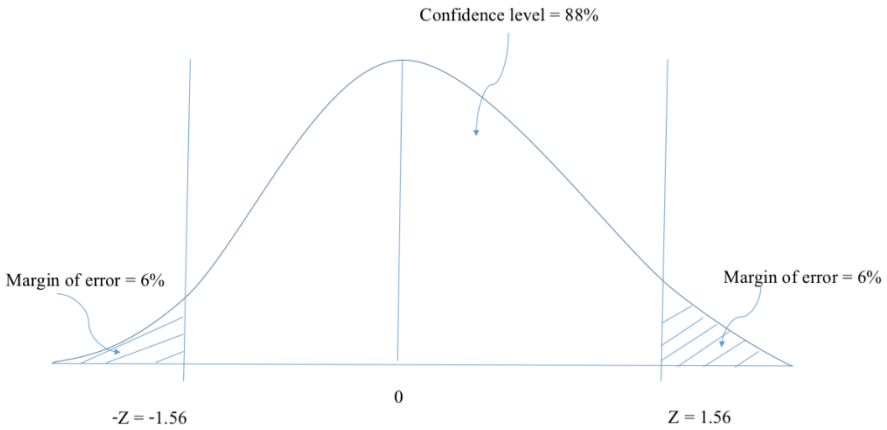

Figure 1- Standard normal distribution.

4.2.1 Confidence level

Thus, if the sample size confidence level uses the most common percentage such as 90%, 95%, or 99%, the survey result could be more accurate and representable. However, due to the concern of limited time in conducting this research study (three months) and man power (one person), the sample size had to be manageable within the limited time. This implies that the confidence level could not be too high, and was at 88% confidence level for this study.

The confidence level is based on z* value for Various Confidence Levels [15], Table 3 shows some of the examples of z^* value. The 88% confidence level corresponds to 1.56 z* value. The confidence level of 88% means that the error is 12%. Based on this 12% error and z* value of 1.56, the sample size can be calculated by the following formula [16]. The probability value of expected true proportion is set to 50%.

Table 3 - Z^* Value for various confidence levels.

Confidence Level	z^* value
80%	1.28
85%	1.44
88%	1.56
90%	1.64
95%	1.96
98%	2.33
99%	2.58

$$n = \frac{z^2 p(1-p)}{e^2}$$

Substituting z = 1.56, p = 0.5, and e = 0.12 into the above equation, the sample size n is

$$n = \frac{1.56^2 * 0.5 * (1-0.5)}{0.12^2}$$
$$= 43$$

4.3 Research method - Questionnaire

In order to design a system truly comprehensive for Medical Tourism aggregative system, this study used a questionnaire to conduct the information from non-Thai-national users who have experiences in using medical service in Bangkok. The format of this market research questionnaire and all the required answers are shown in Appendix 1. The survey results were used for analyzing the importance of data tags in the system. The survey focused on online search patterns, system content preference, and statistical data preference. The evaluation of questions employed the scaling strategy for closed-ended questions, including discrete (Yes/No), multiple choice and ranking. Table 4 shows the type of validity for each question.

Table 4 - Type of question in the questionnaire.

Type of Questions	Number of Questions
User background	1 – 5
Hospital visit experience in Bangkok	6 – 11
Importance of data tags	12 – 13, 22
Online behavior	14 – 18
Research patterns	19 – 21
Expectation in statistical information	23

4.3.1 User background

The information of user's background includes: "Gender", "Age Group", "Annual Income Level", "Nationality", and "Current Residence".

4.3.2 Hospital visit experience in Bangkok

The main purpose of asking these questions was to make sure the interviewees have some experiences in visiting any Hospital in Bangkok. This information could help the system accurately predict the importance of types of informative data tags for each single user. The questions in this section include the type of treatment user undertaken in Bangkok and how many times of treatments.

4.3.3 Data tags importance

Questions in this group concern the importance level for different types of information attracting users to visit those particular hospitals or change to another new hospital. The questions require interviewees to select a rating scale varying from "Very important" to" Not important". The answer from the questions in this group would allow the system to measure the priority of data tag display for a new user from different background.

Data tags with rating scales of importance includes: "Hospital Recognition", "Location", "Map", "Hospital detail contact and address", "Doctor Profile", "Pre-Treatment Support Information", "During Treatment Support Information", "Post Treatment Support Information", "Treatment Cost", "Travel Cost", "Analytical chart", "Patient's reviews", "Promotional Deals", "Outline Famous Department", "Outline Famous Treatment", "Forum", "Blog", and "News".

4.3.4 Online behavior

Questions in this group are mainly for marketing use to show the social media preference and which platform the user uses most for conducting medical related information.

4.3.5 User research patterns

Questions in this group indicate the user preference of the Medical Tourism retrieval system presenting format which are website, mobile application, or both.

4.3.6 Statistical information expectation

Questions in this group show which statistical data that users would like the system to analysis for them and display it as a graph to help users make decision. The information includes: "Hospital Profile" page click rate, "Hospital Profile" page unique visitor number, Hospital Responses rate, Price comparison, Patient experience score chart.

4.4 Data collection.

The data were collected from two sources. The first source is from the foreigners outside hospitals with the sample size of 10% of total calculated sample size. The second source is from some social media groups such as Facebook, LinkedIn, and www.internations.org/forum with the sample size of 90% of total calculated sample size.

4.5 Error elimination

Not all obtained questionnaires were valid for analysis. A questionnaire is discarded if it falls into one of the following conditions.

1. Incomplete questionnaire.
   All questions must be answered. If there existed at least one unanswered question, then the questionnaire was considered incomplete. The corresponding interviewee was disqualified from further analysis.

2. Those foreigners living in Thailand whose ages are over 70 with retirement visa were not considered because they prefer to visit the hospital close to their homes and seldom use any online search for choosing medical providers. They tend to listen to their doctors' recommendations instead of going online to search for medical related information by themselves. Therefore, promotion packages and reviews from other patients cannot influence them and lead them to try a new hospital located far from their homes.

CHAPTER V - KEY FINDING

5.1 Key finding of background information

This survey invited 100 people which were more than the estimated sample size of 43 people to answer the questionnaires. Sixty-five people returned the questionnaires. Among these returned questionnaires, 45 were completely filled and qualified. The analysis is based on 45 questionnaires, which exceeded the targeted sample size of 43. From 45 respondents, 15are males and 30 are females from 12 countries who used 13 hospitals in Bangkok. Twenty two of them (48.9%) are expats living in Thailand. Fifteen of them (33.3%) are living in neighboring countries or territories such as Myanmar, Laos, Hong Kong, and China. The rest of eight respondents (17.8%) are living far from Thailand, such as United States, Canada, United Kingdom, Argentina, Iraq, and Turkey. Fifteen out of twenty expats (68.2%) who live in Thailand chose consultations as their main reason to visit the hospital in Bangkok. These 15 expats living in nearby countries come to Thailand mainly for checkups.

This survey covered patients in 13 hospitals around Bangkok:

1. Bumrungrad International Hospital
2. Bangkok Hospital
3. Samitiviej Hospital
4. Phyathai International Hospital
5. BNH
6. Vichaiyut Hospital
7. Dental Hospital
8. Paolo Memorial Hospital Phaholyothin
9. Christian Hospital
10. Thai Nakvin Hospital
11. King Chulalongkorn Memorial Hospital
12. Sikarin Hospital
13. Theptarin Hospital

The respondents are from 12 countries (Chinese, Spanish, Australian, Italian, British, Moldovan, Dutch, Swiss, French, Russian, Filipino, and Bosnian). But their actual resident countries are Thailand, Hong Kong, China, Myanmar, Laos, Canada, United States, United Kingdom, Argentina, Iraq, and Turkey. The respondents' ages and incomes are summarized in Table 5.

Table 5 – The age group and annual income level (in USD).

Income / Age	<12000	13000 – 35000	36000-55000	56000-75000	76000-99000	100000<	Total
20-29	1	3	3	0	0	0	7
30-39	4	6	1	3	4	3	21
40-49	1	1	0	0	2	5	9
50-59	0	1	1	0	2	2	6
60-69	0	0	1	0	1	0	2
Total	6	11	6	3	9	10	45

5.2 Key finding of online search preference

All the interviewed people tend to use search engines to look for medical related information, especially in the age group between 30-39 as shown in Figure 2.

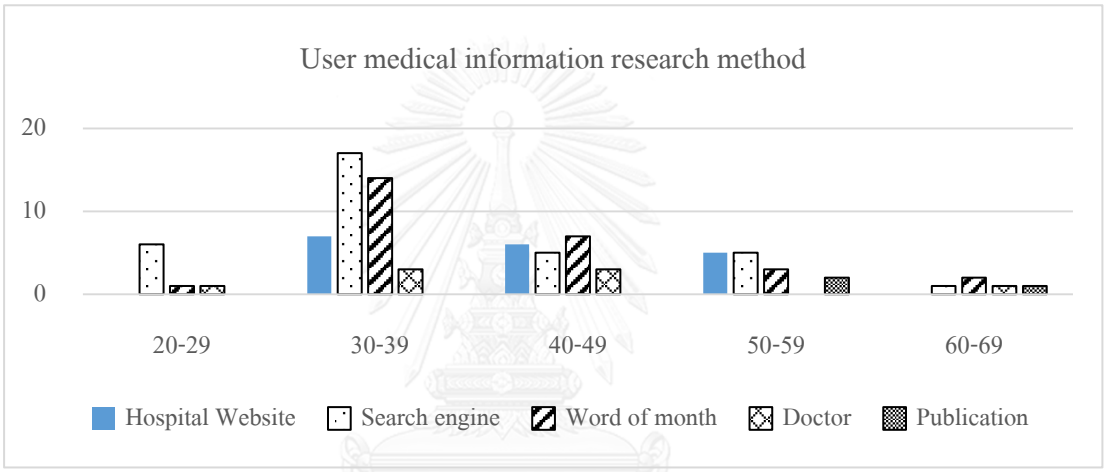

Figure 2 – User medical information research method.

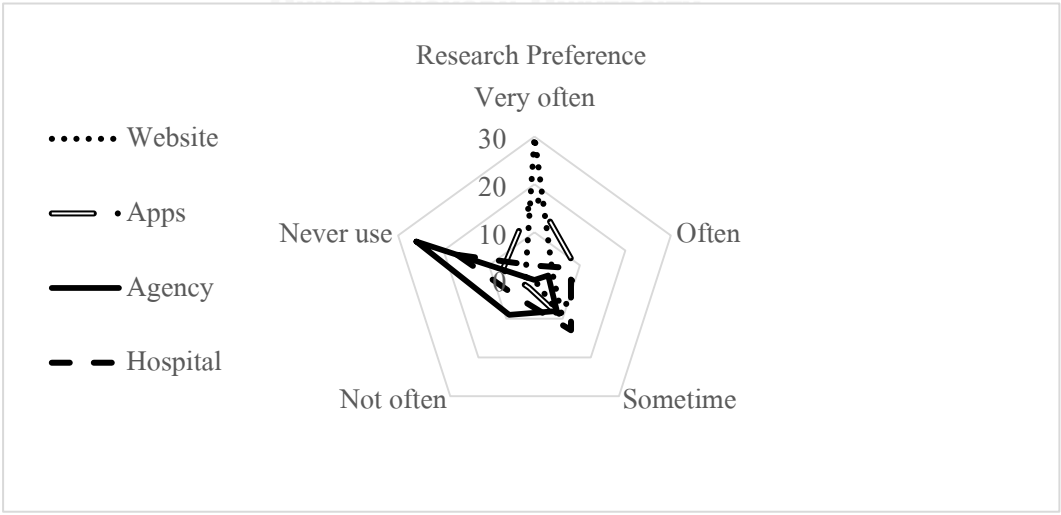

Figure 3 – Four top degrees of preference channels for obtaining the medical information.

In case of preferred information channels, none of the participants (0/45) use any agency to book their medical treatments aboard but they do very often search treatment information online. Figure 3 shows 4 top degrees of preference channels for obtaining the medical information online. Some people may use applications and contact hospitals directly. Even though people prefer to use websites in their medical related search, 46% of users as indicated in Figure 4 state that a new proposed Medical Tourism aggregative system should be available in both website and application formats.

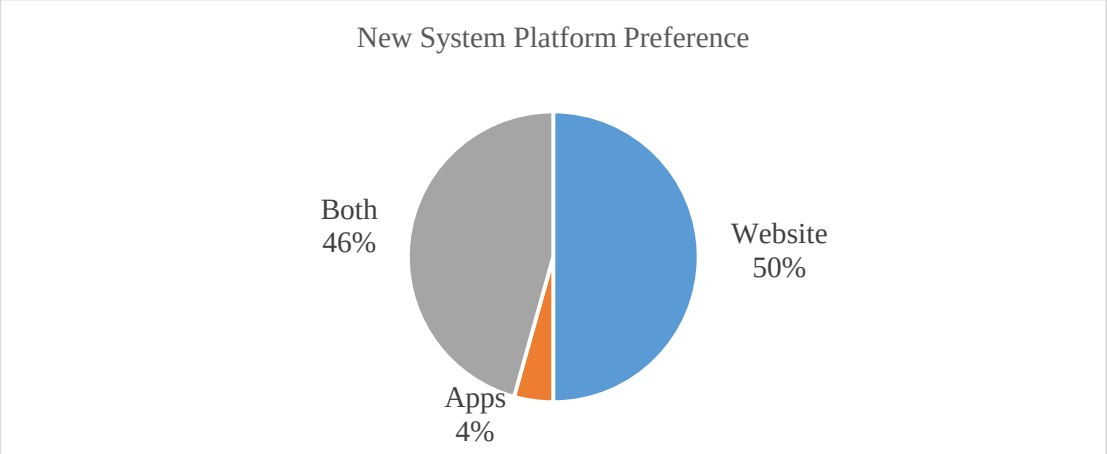

Figure 4 – The percentage of users preferring to use format of new proposed Medical Tourism aggregative system.

5.3 Key finding of data tags preference

Table 6 shows the participants' preferences of different data tags in Medical Tourism website. Note that people from different background have different weights of data-tag importance with the same outcome (search for the hospital in Bangkok).

Table 6 – Survey result – Data tags importance.

	Very Important	Important	Neutral	Less Important	Not Important	Total Number of people
Location Map	22	13	7	1	2	45
Hospital Details	16	14	9	4	2	45
Doctor Profile	17	18	7	3	0	45
Hospital Accreditation (Certificate)	27	8	7	1	2	45
Comments (Patient's reviews)	14	20	5	3	3	45
Pre-treatment support	6	15	11	7	6	45
During treatment support	10	22	5	4	4	45

Post treatment support info	10	19	9	4	3	45
Other cost	6	15	9	6	9	45
Travel cost	8	9	13	3	12	45
Feature treatments	12	13	13	4	3	45
News	5	18	12	6	4	45
Forum	9	14	11	9	2	45
Blog	6	9	13	11	6	45

For the opinions on essential data tags on a web page, the most participants indicated that "Blog" section, "Travel Cost" information, "Click Rate" and "Unique Visitor" data are not important for them. Ten out of fifteen participants who supported "Blog" section have relatively low incomes (less than <35k US dollar). Therefore, it is not so valuable to add "Blog" section at this point. Nine out of seventeen participants who indicated "Travel Cost" information is important that they are in low incomes group too and four out of these people are living in Thailand. Thus, this data tag is not the key target segment for the Hospital. These two data tags are shown in bold fonts and the highlighted entries show the numbers of participants giving the opinions to these data tags.

About "Click Rate" and "Unique Visitors" data, Figure 5 shows that the demands from the users are low according to this research. However, it is easy to add it through Google Analytics and Google Data Studio in the future when the system needs it. Therefore, these four features of data tags would not appear in the user interface of proposed system.

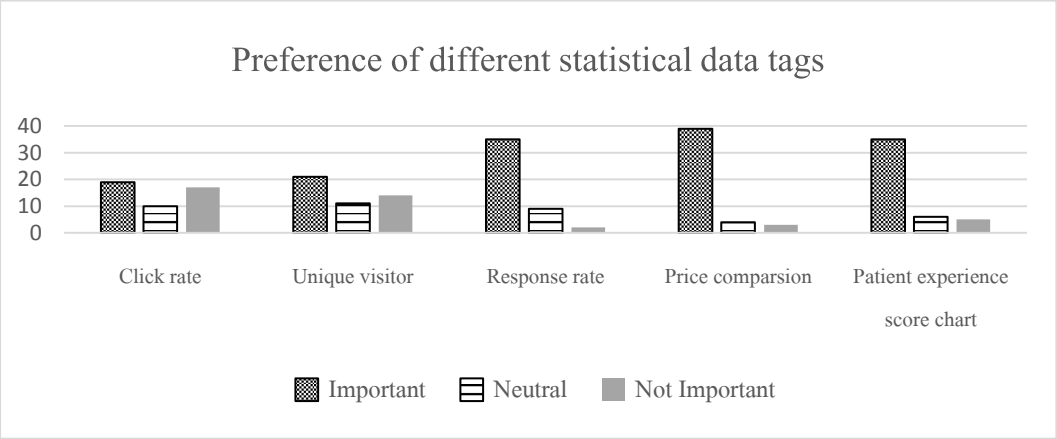

Figure 5 – Preference of different statistical data tags.

5.4 Key finding of correlation between user and data tags

Figure 6 indicates that when users are expats living in Thailand, the hospital map is "Very Important" for 12 out of 22 people and "Important" for 7 out of 22 people. In contrast, for the foreigners who live far distance from Thailand such as America, Europe, Middle East and come to Thailand for Medical Tourism, the map for them is

not essential when compared to other critical information. In Figure 7, 8 out of 15 people living in the countries near Thailand such as Hong Kong, China, Myanmar, state that the information of accommodation, flight ticket, insurance, local tour, translator, medical package, travel agency contact are important for them.

Residence **0** = Thailand; **1,2** = Other Asian countries that are close to Thailand; **3,4,5** = Countries that far away from Thailand.

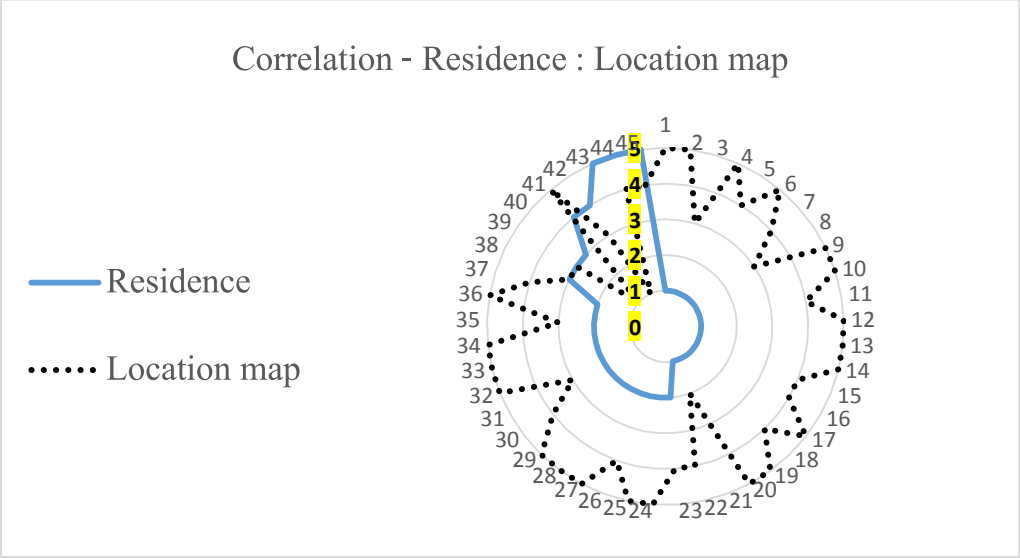

Figure 6 – Correction – Location map data tag importance for people who live in different countries.

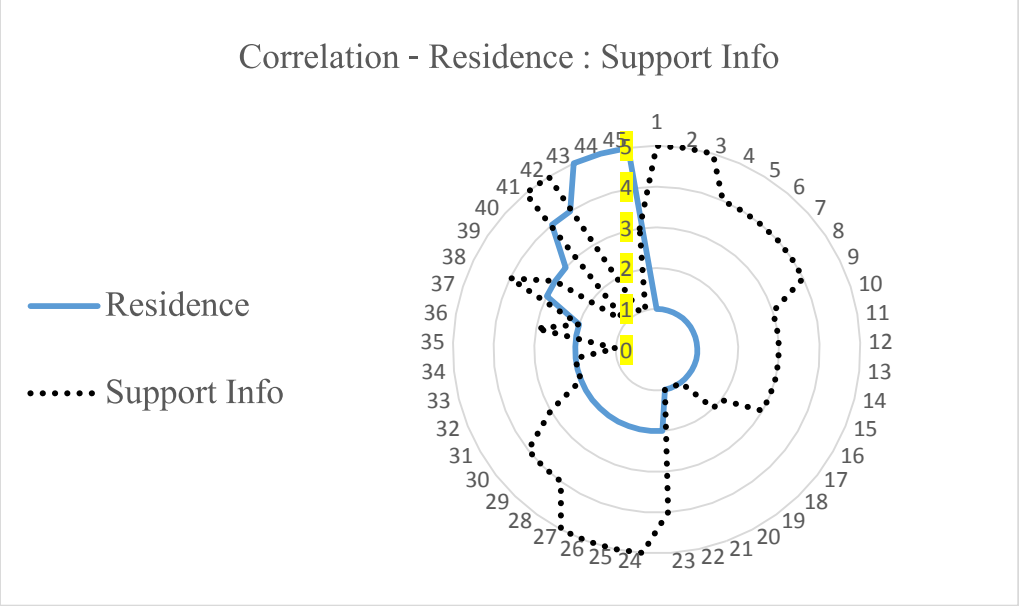

Figure 7– Correlation – Support info importance for people who live in different countries.

5.5 Key finding of correlation among data tags

The survey result also showed that there is a correlation among some data tags. When users think one data tag is important for them, it might be possible to assume that some other data tags are also important to them, even though they did not express this in the survey or did not click it when they used this proposed system. This is because users expressed that the importance of one data tag is linked to another one. Therefore, there is a pattern between some particular primary data tags and secondary data tags. The correlation assumption is based on the importance level of each data tag. In the survey, scores 5 is very important and 1 is not important. The total score for each data tag is 225 (Maximum rating 5x45 participants). One of the examples from the following patterns is "Hospital profile and contact". Nineteen participants (19 out of 45) indicated this data tag is very important for them (Score of 5x19). Another similar number of 19 participants indicated the data tag is important for them (Score of 4x19). But six participants indicated a neutral option for them (Score of 3x6) and one participant indicated that it is less important. (Score of 1x1). Therefore, the total rating for "Hospital profile and contact" data tag is 191/225. When the importance of data tags of "Certificate" and "Doctor Profile" is close to the rating of "Hospital profile and contact", it means that the users have similar importance weights of these data tags in the list and a high chance to feel that "Certificate" and "Doctor Profile" are also important for them. The following correlation patterns were found from the survey.

1. Hospital profile and contact (191/225), Certificate (192/225), and Doctor Profile (184/225). This means whoever choosing "Hospital profile and contact" as an important data tag also feels that "Certificate" and "Doctor profile" are rather important data tags.

2. Other cost (138/225) and Promotion (147/225). This means whoever choosing "Other cost" as an important data tag also feels that "Promotion" information is a must.

3. Pre-treatment support information (165/225), during treatment support information (165/225), and Post-treatment support information (164/225). This means whoever choosing "Pre-treatment support information" data tag also feels that "Post-treatment support information" and "During treatment support information" are important data tags.

CHAPTER VI - PROPOSED SYSTEM STRUCTURE

The proposed Medical Tourism aggregative system minimizes the gap between the different types of data tag availability and user expectations at the end to reduce the user information search and retrieval time in making decision making based on the statistical data graph format. It creates a level of personalized experience for users by improving the priority of site navigation displays based on user's personal data and page view preferences. This system is also an evolution of decision support concepts to provide better visualizations by graphic displays. Some data mining tools [11, 17] such as Association Rule technique [18] was included to find the correlation of users preferences based on users background with customized display data tags for each individual user. The architecture of proposed system is shown in Figure 8. The system consists of three main modules which are data warehouse modules, analytic modules, and user interface modules.

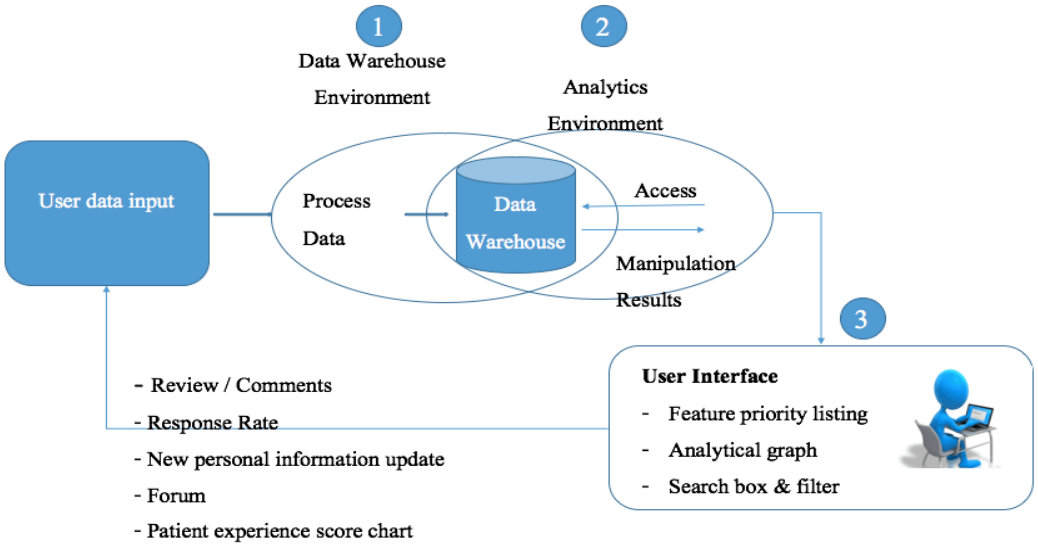

Figure 8 – The architecture of proposed Medical Tourism aggregative system.

The user interface process flow is shown in Figure 9. The sequence starts from inputting user's information. The last outcome of the system is a set of recommended data tags. Pre-treatment support data tag includes accommodation, insurance, international travel arrangement. During treatment support data tag includes additional medical package, local transportation, translator, local tour, daycare service, and additional restroom for accompany. Post-treatment support data tag includes after-care service, appointment follow up, and recovery follows up.

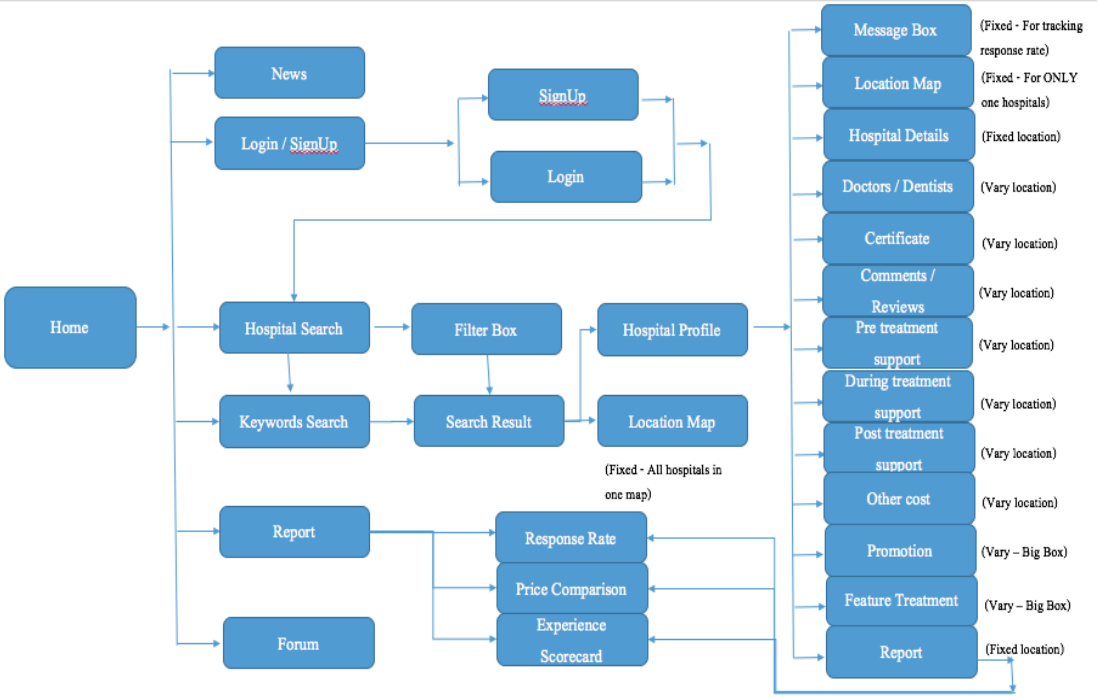

Figure 9– User interface process flow.

The primary matching sources is “Income”, “Age”, “Gender”, “Nationality”, “Residence”. The system provides four priority spots to display data tags in the most eye catching location. Modeling technique going to use in overall system is ER Modeling which captures the entity relationship the form of entity-relationship (ER) diagram. It shows each data tag in a graphical format and the relationships of data tags. Figure 10 shows the following eight entities of data-tag relationship and their attributes.

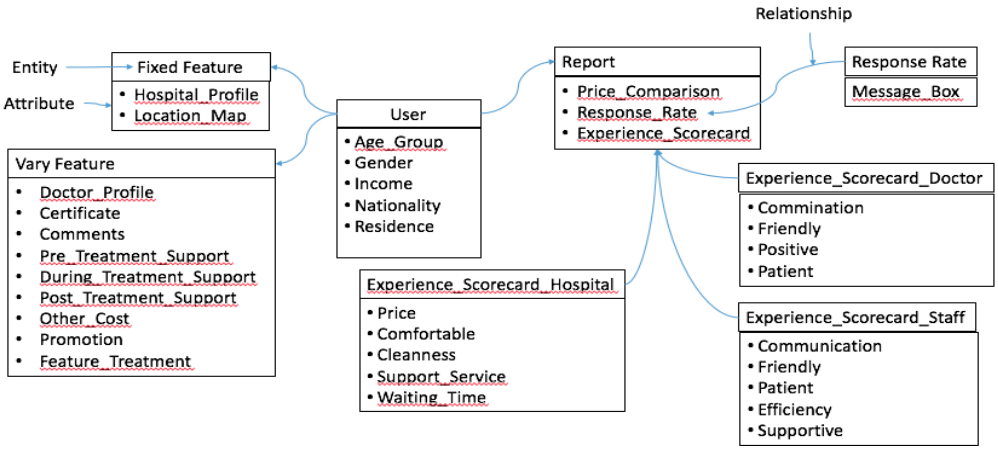

Figure 10 – Model technique for operational process captured by ER diagram.

As shown in Figure 11, once a user registers in the system as a new user, the system checks the background of user. If the background matches the item set in the system, then the system will display the data tags accordingly to this new user background. Otherwise, the system will display the default data tags' display for this new user. For other new following users, the system should able to learn the users' data tags preference patterns from those users previously visiting and to adjust the data tags display accordingly.

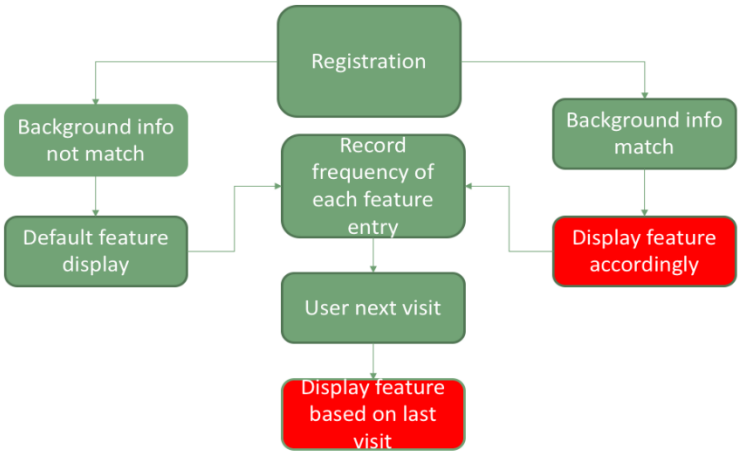

Figure 11 – System process flow.

One of the considerations of data tag location is the degree of importance from the participants. In Table 7, not only all the tag's allocations are shown, it also indicates all tags scales of importance based on the survey result, i.e. 1st is the most important and 15th is the least important. The total score for each tag is 225 (45 Participants and maximum score scale of 5).

The server extracts the user personal data from data warehouse and analyzes it. The data report will be generated by Association Rule algorithm as an example. Once the user logs in to the system, the system will consider the user personal information or previous visit history to allocate the best fit data tags on User Interface. In this proposed system, there are two ways to display data tags which are "fixed location" and "varied location" as shown in Table 8.

Table 7 – Data tags allocation.

Data tags	Homepage	Search Result Page	Hospital Profile Page	Analytical Page
Certificate (Hospital accreditation) (192/225) – 1st			√	
Hospital profile (191/225) – 2nd			√	
Keywords search (188/225) – 3rd	√	√	√	√
Location map (187/225) – 4th		√	√	
Outline famous treatment (187/225) – 5th			√	
Doctor profile (184/225) – 6th			√	
Comments (174/225) – 7th			√	
Pre-treatment support information (165/225) – 8th			√	
During treatment support information (165/225) – 9th			√	
Post treatment support information (164/225) – 10th			√	
Treatment list (162/225) -11th			√	
Forum (154/225) – 12th	√			
News (149/225) – 13th	√			
Promotion (147/225) – 14th			√	
Other cost (138/225) – 15th			√	
Response rate (185/225)			√	√
Price comparison (185/225)			√	√
Patient experience score chart (181/225)			√	√

Table 8 – Data tags fixed and vary locations.

"Fixed location" (always at the same location no matter who logs into the system)	- Keyword search - Location map - Promotion ad box (In the country that user viewing) - Treatment ad box (In the country that user viewing) - Hospital profile - Forum - News (General)
"Varied location" (based on different users and appeared in different priorities)	- Certificate (Hospital accreditation) - Doctor profile - Comments - Pre-treatment support information - During treatment support information - Post-treatment support information - Treatment listing - Outline famous treatment (In the hospital that user viewing) - Other cost - Promotion (In the hospital that user viewing) - News update (In the hospital that user viewing)
"Fixed location" (always at the same location no matter who logs into the system)	- Response rate - Price comparison - Patient experience score chart

The data collected from the survey will be a first item set to setup the system. The system uses these data to generate the graph displayed on the user interface. The graph will be continuously updated when there are more users entering and using the system features to access hospital information. The reviews are posted after their hospital visit in "Patient Experience Score Chart". In addition, some features will also be continuously updated every time after the user inputs new information to the system such as comments, review, and forum. The inputs and reported outputs of the system are the followings.

1. The system response is based on the user personal information (Age Group, Gender, Income, Nationality, and Residence) to arrange positions of data tags in varied locations.

2. User can read all reports in Report section.

3. Data in Report / Price Comparison sections are provided by hospital and input by administrator.

4. Data in Report / Response Rate section are based on how fast hospital response to user's enquiry. The response time can be tracked only if the message is sent out from the message box in the system.

5. Data in Report / Experience Scorecard section have three sub-categories which are Hospital, Doctor, and Hospital Staff.

6. Data in Report / Experience Scorecard / Hospital section are inputted by users which are customer satisfaction score rating for treatment pricing, comfortable level, overall cleanness, support service, and waiting time.

7. Data in Report / Experience Scorecard / Doctor section are inputted by users which are customer satisfaction score rating input when users interact with their doctor in terms of communication, friendliness, positive, and patient.

8. Data in Report / Experience Scorecard / Staff section are inputted by users which are customer satisfaction score rating input when users interact with hospital staffs in terms of communication, friendliness, patient, efficiency, and supportive.

The modeling technique used in the Report section is Star Modeling whose details are shown in Figure 12. The experience scorecard reporting graphical diagram will also be shown on the website in spider format.

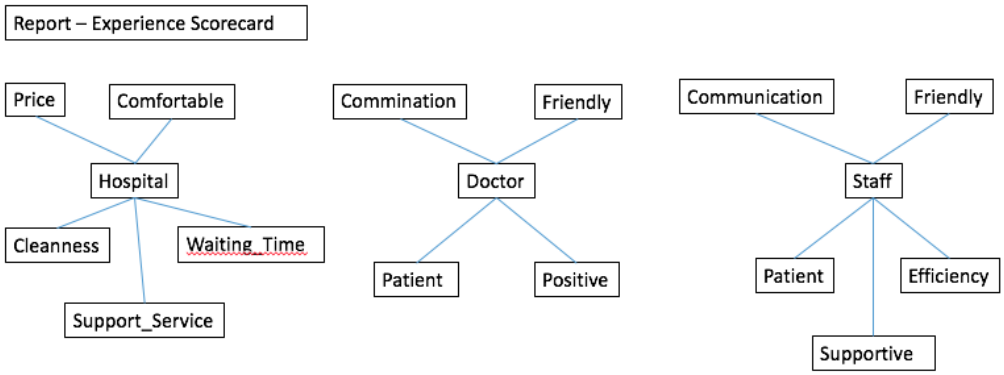

Figure 12 – Model technique for analytical report section – Star Modeling.

CHAPTER VII - ASSOCIATION RULE

Association Rule consists of three main steps. The first step is to mine all frequent item sets. The second step is to identify the support level. The third step is to identify the confidence level. In this paper, the standard of minimum support level is set to 40% and minimum confidence level is set to 90%. The Data mining report has used Microsoft SQL server Data Mining Add-ins (for Microsoft Office 2007 and 2010) - SQL server management studio (SSMS) and SQL server data tools (SSDT) to analyze the survey result and generate the analysis report.

7.1 Step 1: Mining all frequent item sets

At the beginning, the system will have 11 data tags available for users to be used. The illustration of each data tag is defined by its priority computed from the statistical analysis of collected data. Since the system provides four priority spots for data tags to be displayed, there will be four levels of item sets. Figure 13 shows the detail of combination of item sets in each level and the total number of item sets in each level. The available data tags in the system are the followings.

[1] Post-treatment support information
[2] Pre-treatment support information
[3] During treatment support information
[4] Certificate
[5] Doctor profile
[6] Comments
[7] Other cost
[8] Treatment list
[9] Feature treatment
[10] Promotion
[11] News update

The number of combinations of item sets in each level can be computed from n!/r!(n-r)!, where *n* is the number of items (11 items) and *r* is the selected or considered items.

Level 1 = 11
Level 2 = 11x10x9x8x7x6x5x4x3x2x1 / (2x1) (9x8x7x6x5x4x3x2x1) = 39,916,800 / 725,760 = 55

Level 3 = 11x10x9x8x7x6x5x4x3x2x1 / (3x2x1) (8x7x6x5x4x3x2x1) = 39,916,800 / 241,920 = 165

Level 4 = 11x10x9x8x7x6x5x4x3x2x1 / (4x3x2x1) (7x6x5x4x3x2x1) = 39,916,800 / 120,960 = 330

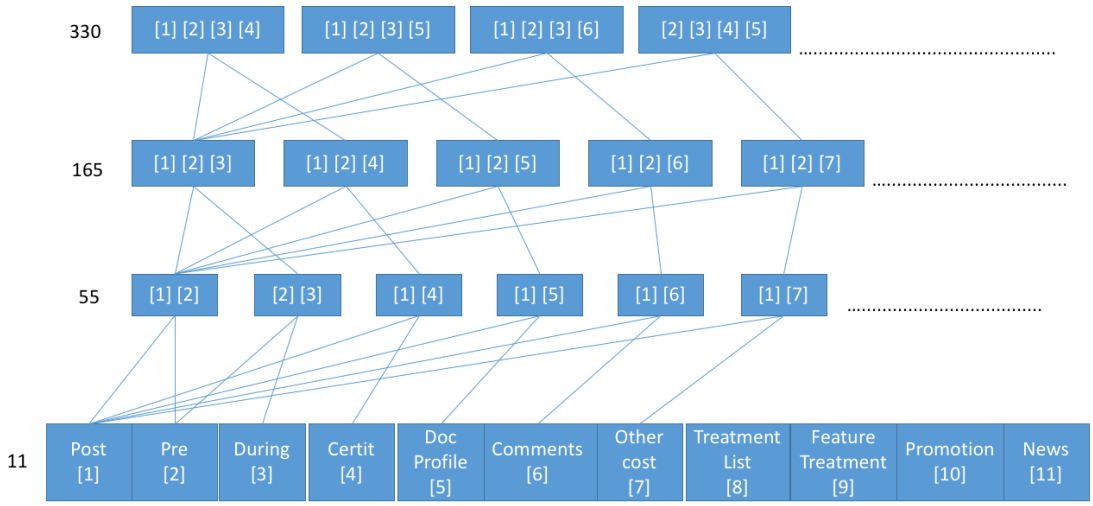

Figure 13 – Combination of item sets and the total number of item sets in each level.

7.2 Step 2: Identifying support level

At the beginning, the support level number is based on the survey result. The system will count one when a participant indicates that particular data tags is "Very Important" for him. However, the support level can be easily obtained by counting the number of clicks in each data tag for each user. The more frequent clicks mean the data tag is more important to this user.

Even though the system has spotted maximum four item sets according to the survey, the maximum item sets from 45 respondents are only three item sets. In this case, the last spot in the priority location will be set as default and shown as "Comments" because this data tag is one of the most important features for users according to Table 6, i.e. 76% (34/45) of interviewee indicated that "Comments" is important for them. In Table 7, "Comments" is the 7th most important data tag for interviewee. Table 9 is the support level report generated by Microsoft SQL server Data Mining Add-ins Association Rule tool. The example data set shown at the 5th location from the top in the Table 9. The meaning of support level is the number of users who choose those data tags in the list as important for them. In this example, 18/45 (equivalent to 40% set as the minimum requirement for support level) is the number of users in database that indicated [Post treatment support], [Certificate], and [Doctor Profile] are all important for them. In this case, the system will display [Post Treatment support information], [Certificate], and [Doctor Profile] in the priority spot and the last priority sport will be shown as "Comments".

Table 9 – Support level.

%	Support	Size	Itemset
44%	20	3	Post treatment support = Existing, Outline famous treatment = Existing, Doctor profile = Existing
42%	19	3	Post treatment support = Existing, Comments = Existing, Doctor profile = Existing
42%	19	3	Comments = Existing, Certificate = Existing, Doctor profile = Existing
40%	18	3	Comments = Existing, Outline famous treatment = Existing, Certificate = Existing
40%	18	3	Post treatment support = Existing, Certificate = Existing, Doctor profile = Existing
53%	24	2	Certificate = Existing, Doctor profile = Existing
51%	23	2	Outline famous treatment = Existing, Doctor profile = Existing
51%	23	2	Comments = Existing, Doctor profile = Existing
49%	22	2	Post treatment support = Existing, Doctor profile = Existing
47%	21	2	Comments = Existing, Outline famous treatment = Existing
44%	20	2	Outline famous treatment = Existing, Certificate = Existing
44%	20	2	Post treatment support = Existing, Outline famous treatment = Existing
42%	19	2	Post treatment support = Existing, Comments = Existing
42%	19	2	Comments = Existing, Certificate = Existing
40%	18	2	Treatment listing = Existing, Certificate = Existing
40%	18	2	Promotion = Existing, Doctor profile = Existing
40%	18	2	Post treatment support = Existing, Certificate = Existing
62%	28	1	Doctor profile = Existing
58%	26	1	Certificate = Existing
56%	25	1	Outline famous treatment = Existing
51%	23	1	Comments = Existing
49%	22	1	Post treatment support = Existing
42%	19	1	Treatment listing = Existing
40%	18	1	Promotion = Existing

7.3 Step 3: Identify Confidence level

Table 10 is an example of the Association Rule generating the report of confidence level (It also shown in 6th page of Appendix 2 Associate data tags – Probability (Confidence level) full report – page 65). The meaning of this report is 22 users in the database indicated [Post Treatment support information] and [Certificate] are important to them. The system predicts [Doctor profile] is 100% (22/22) important to these 22 users too. The full report is shown in Appendix 2 with the minimum 90% confidence level requirements.

Table 10 – Confidence level.

Probability	Rule
100 %	Post treatment support = Existing, Certificate = Existing -> Doctor profile = Existing

Therefore, [Post Treatment support information] & [Certificate] are antecedent, [Doctor profile] is a consequence. [Post Treatment support information] & [Certificate] ⇒ [Doctor profile] [40%, 100%]

In this case, [Doctor profile] will appear on the top and prominent location of the Hospital profile page along with [Post Treatment support information] & [Certificate]. This rule will be applied to both new users and re-visiting users.

CHAPTER VIII - IMPLEMENTATION AND VISUAL DESIGN

Table 11 shows some of the data collected from survey. According to the table, the different background of users will desire different information with same outcome (finding the hospital for their treatment). The score of five points indicated that the particular data tags of information is the most important for these users and one point indicated that particular data tags of information are less important for these users.

An example of how to use Association Rule to manipulate the result to achieve personalize the display page for each single user will be discussed by using the data from Table 11.

Table 11 – Example of data collected from survey.

Gender	F	M	F	M	F
Age	40-49	40-49	40-49	40-49	40-49
Income	100k<	100k<	13-35k	100k<	76-99k
Nationality	Spinach	American	American	Chinese	American
Residence	Myanmar	US	Laos	HK	Thailand
Treatment	Check-up	Consultation	Check-up	Check-up	Consultation
Certificate	5	5	1	5	5
Hospital profile	4	3	5	5	5
Doctor profile	5	4	4	5	5
Pre-treatment support info	4	3	5	4	4
During treatment support info	5	2	5	5	3
Post-treatment support info	4	1	5	4	4
Review	4	4	5	5	5
Other cost	4	1	3	4	4

8.1 Registration Page

In Key Finding summarized in Chapter 4, it was found that the personal data collected from questionnaire is good enough to provide unique item set for analysis. Therefore, the registration page data required from users is same as that in the questionnaire, i.e. Gender, Age group, Annual income range, Residence, and Nationality.

When a user fills out the form in a register page, the data will go into the data warehouse and the system starts analyzing the data and doing the matching of items in the database. The following person is an example to run in this Medical Tourism aggregative system.

Female. 40-49 Years old Annual income USD100k < Spinach living in Myanmar Looking for Dental work

The system will immediately identify the above new user whether his data are in one of the 45 people's survey data, and the Association Rule technique will select the proper "Hospital profile" page.

8.2 Search Result Page

According to the survey key finding, 82% of users think keyword search and filter box are important (22/45 indicated very important and 15/45 indicated important). Therefore [Filter box] and [Keyword search] will appear in [Hospital Search] page, [Report] page, and [Forum] page as shown in Figure 14.

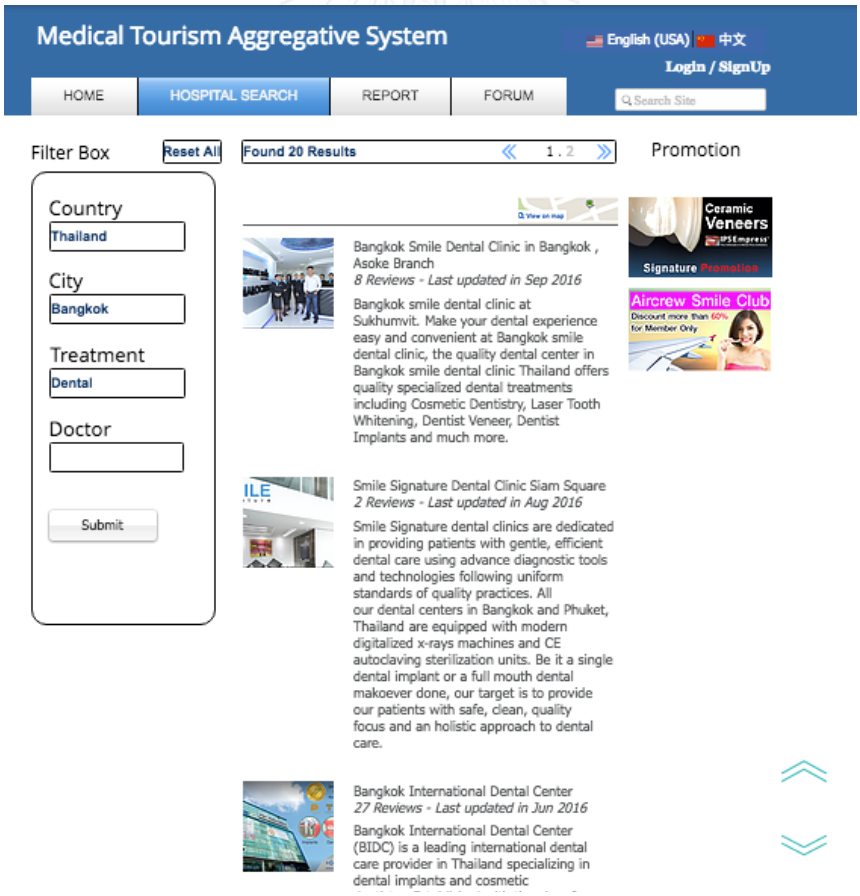

Figure 14 – Example of hospital search result page.

The [Search Result] Page will be similar to other Medical Tourism websites. However, it has embedded Google Map in the list as shown in Figure 15 where the user is able to see the locations of all hospitals in one map.

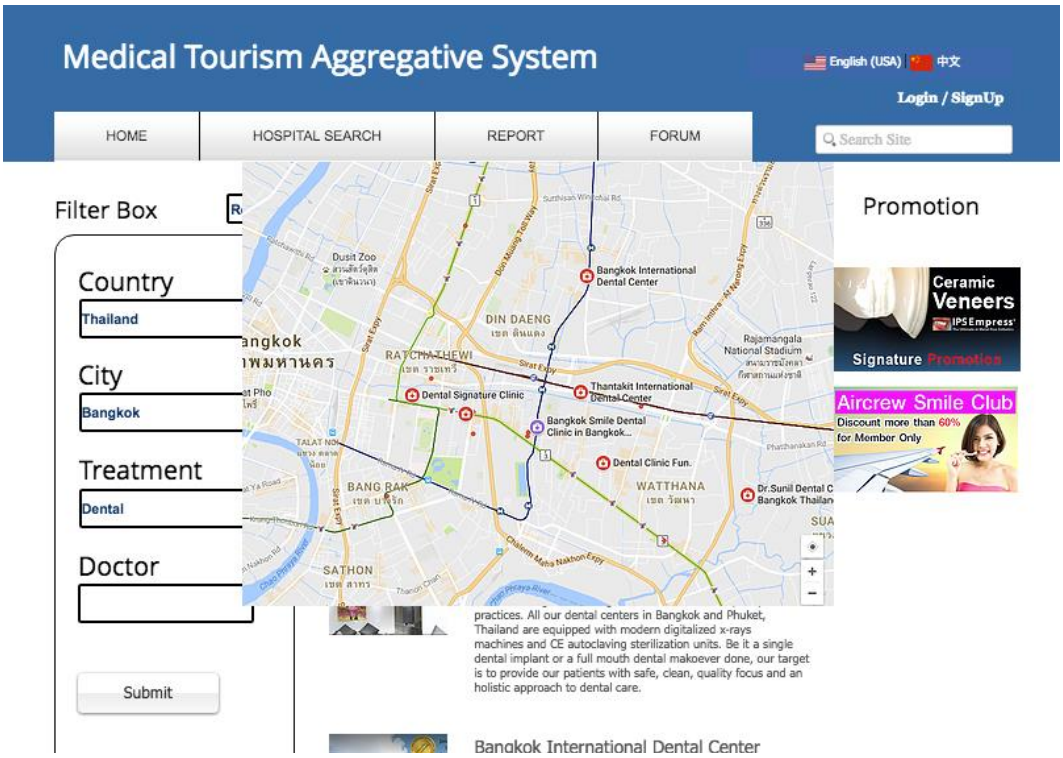

Figure 15 - Example of hospital location map.

8.3 Hospital Profile Page – Applied Association Rule

To improve the accuracy of data mining, the concept of Hybrid Dimensional Association Rule was adapted to analyze the data for Hospital Profile Page, especially the location of hospital. A priori Algorithms which are Elcat Algorithms and F.P. Growth Algorithm were used to mine Association Rule. The display of data tags on this page is based on these three scenarios.

Scenario 1:

Based on user's personal details which are Gender, Age, Income level, Residence, Nationality are compared and matched with the item sets in the database.

Scenario 2:

If a new user is not 100% matched with any item set in the database, then the new user is added to into the database. According to Association Rule technique, the system will scan the database to find whether there are any possible data tags that might be important and interested by this new user based on the support level and confidence level. For example in Table 11, this new user matched one items set in the database which is [Post-treatment support information]. But [Doctor profile] is the most important to he/she causing the system to display these two data tags in the priority spot, detail shown in Table 12. As mentioned in Chapter 7, the system has four priority

spots in the interface. Therefore, the system uses [Post-treatment support information] and [Doctor profile] to predict what are other two data tags which might also be important for this user.

Table 12 – Example of data tags importance level.

Most Important	Post-treatment support information Doctor profile
Secondary Important	Certificate (Hospital Accreditation) Comments (Hospital review) Pre-treatment support information During treatment support information Treatment list Feature treatment Other cost Promotion News

Scenario 3:

After a user first visits to the website, the system will record the click frequency of all data tags from the user. When the user logs in the system next time, the system will base on user previous visit and adjust the data tags' location and prioritize the most important data tags on prime location.

"Priority spot" has total five spots to display data tags. It has one fixed space for [Hospital profile], four spots for any data tags that might be important for each user. The rest data tags are displayed on the left side of the webpage as shown in the example interface in Figure 16.

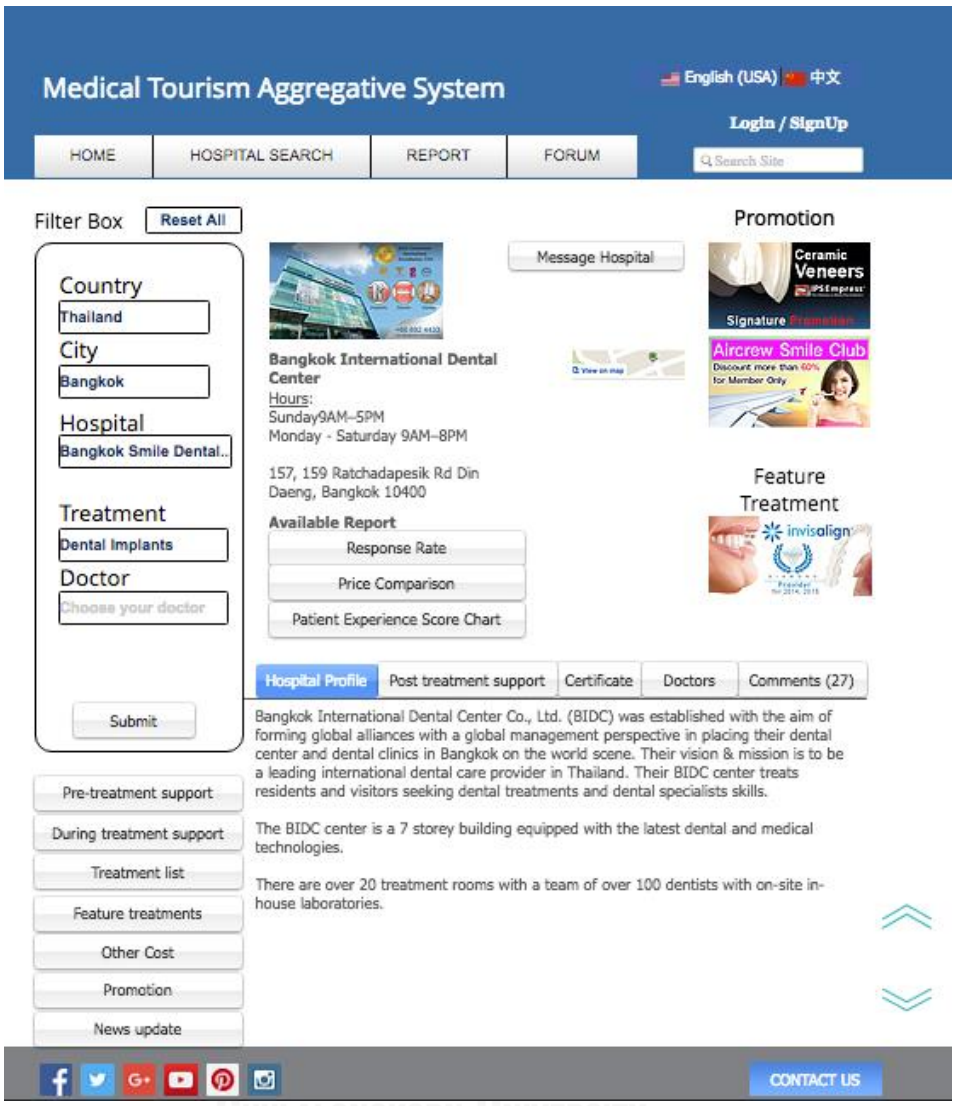

Figure 16 – Example of hospital profile page.

The system sequence starts from inputting user's information. The last outcome of the system is a set of recommended data tags. [Pre-treatment support information] includes accommodation, insurance, international travel arrangement. [During treatment support information] includes additional medical package, local transportation, translator, local tour, daycare service, and additional restroom for accompany. [Post-treatment support information] includes after-care service, appointment follow up, and recovery follows up. Figure 16 is an example of actual user interface on this new Medical Tourism website demo. Users can access the data in a variety of ways that are relevant or important to their particular needs, which means each single user will see different data tags allocation on "Hospital Profile" page. Also, the "Comments" section is combined two sources: 1. Comments input from user in this system, 2. Review from Google.

8.4 Analytical report page

Figure 17 to Figure 19 show three available analytic reports with statistical data for users to read under "Report" section. The same concept has been used in many big online retail companies such as Amazon, eBay, Walmart, Macy's. They use data analytics to enhance their customer's online shopping experience [18]. With similar functionality, the same system could apply in Medical Tourism website too. The analytical report could be generated by an OLAP server [19].

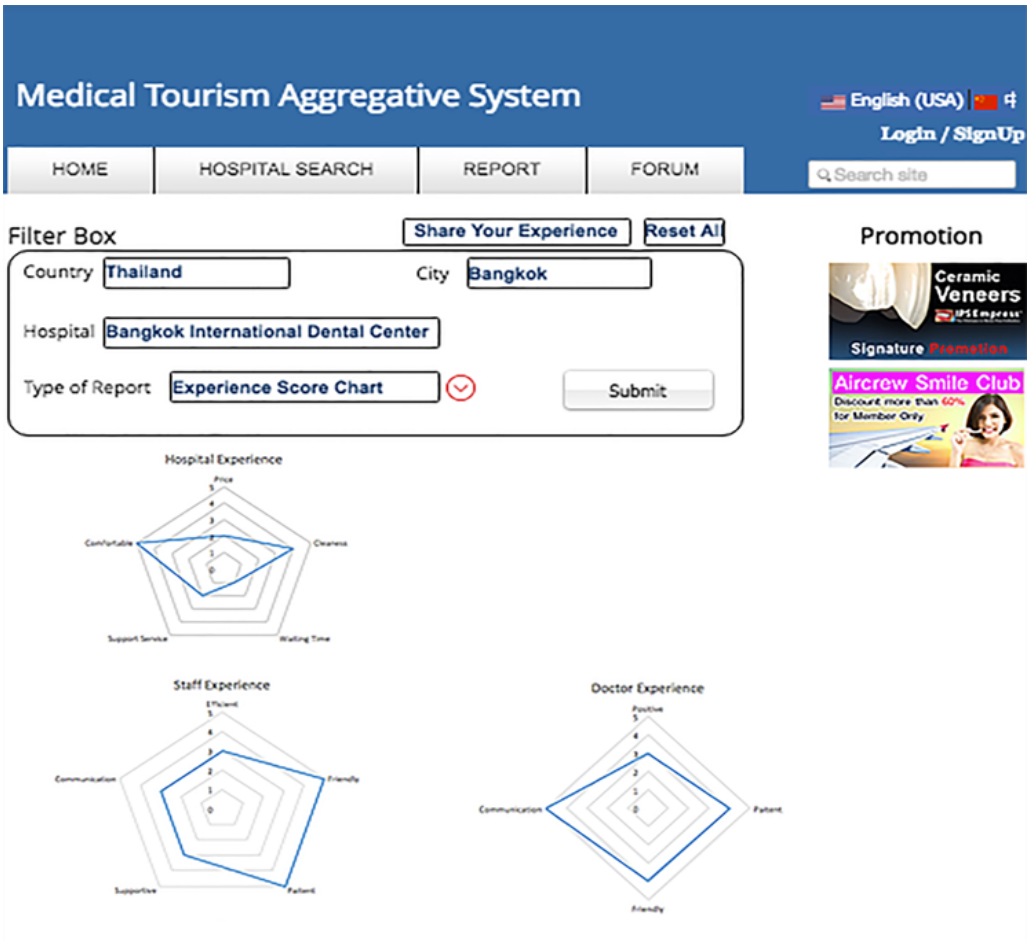

Figure 17 – Example of analytic graph report – Experience score chart.

Figure 18 - Example of analytic graph report - Price comparison with same type of treatment (Dental implant in example).

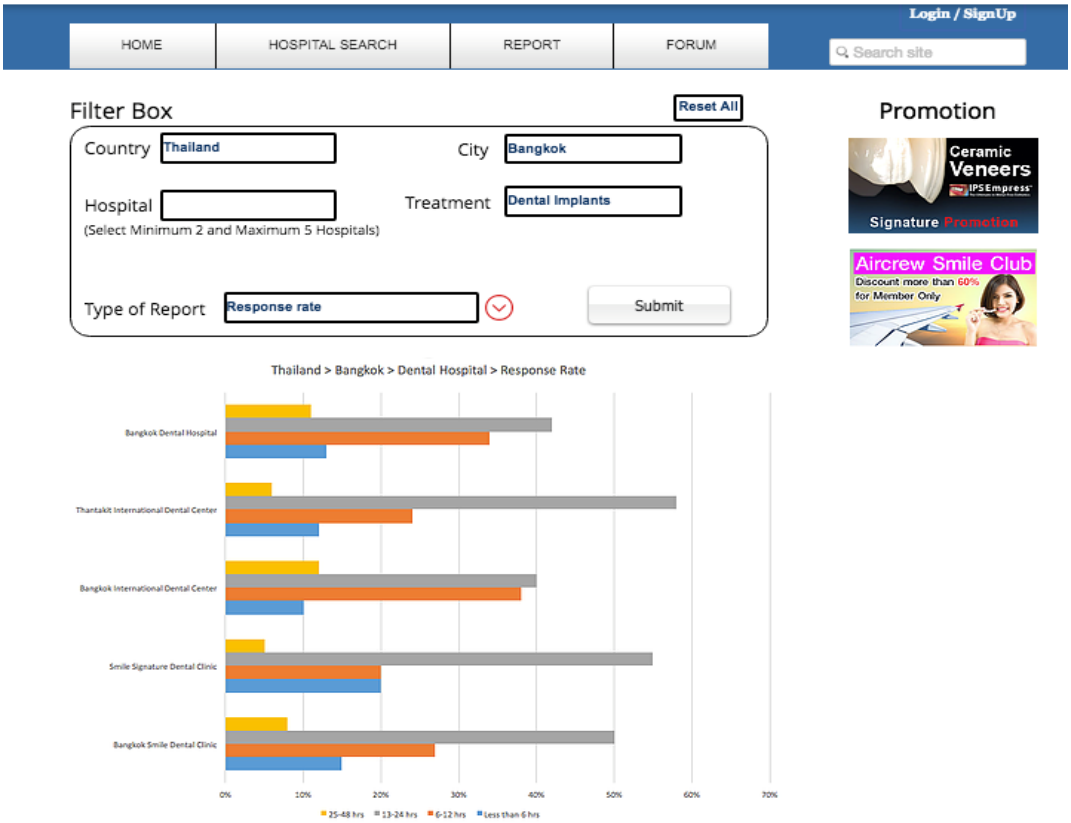

Figure 19 - Example of analytic graph report - Medical service provider response rate.

8.5 Mobile application

Figure 20 shows the search results in application format. The information is displayed vertically and the sequence listed from the top is: Hospital address and map →Analytical chart → Data tags that are important for users (based on database analysis) → Data tags that are less important for users (at the bottom). The Application should be available in both Android and iPhone formats.

The displayed user interface is just one of the examples. The data tags display priority is based on the users' personal information. Therefore, the display of another user may be differently. "Post Treatment Support" might not be displayed on the top of the list.

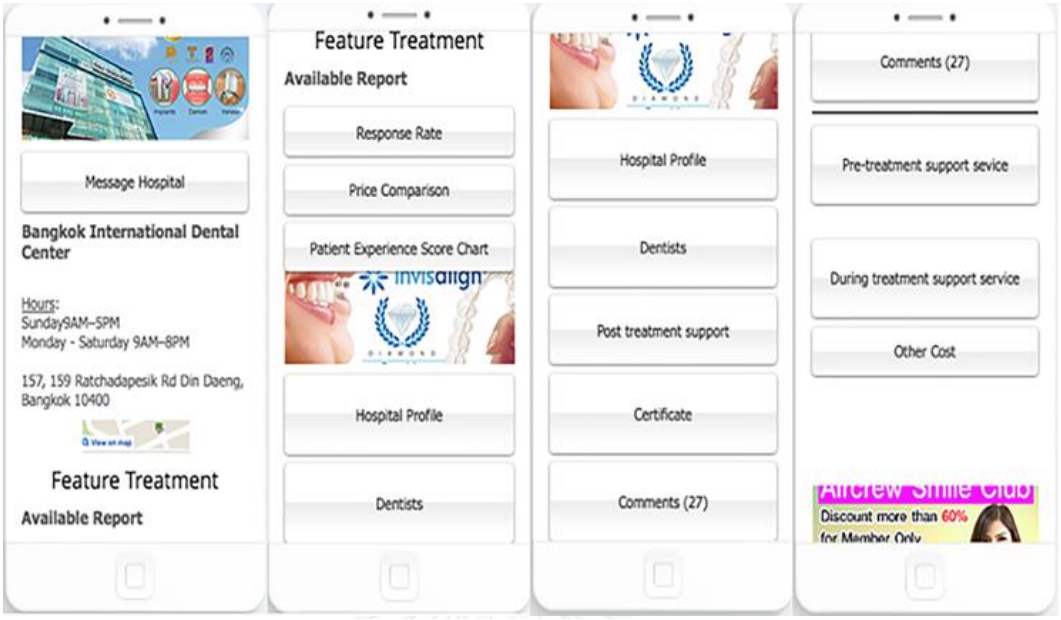

Figure 20 – Example of application format showing the hospital profile page.

CHAPTER IX - SYSTEM EVALUATION

This paper has invited six foreigners in Bangkok to evaluate the proposed system. The format of questionnaire is shown in Appendix 3. The method of conducting the data is by observation and answering the questionnaire. All invited interviewees were randomly selected on the street in Bangkok. The main purpose of this evaluation is to prove the proposed system is better and more practical than other existing systems or websites. The following table is the result of system evaluation.

Participants need to visit three websites and find the Dental hospital in Bangkok. Then they must open the hospital profile page that provides basic information about the hospital containing location, contact number, hospital brief description, accreditation, treatment list etc. This survey required participants to provide basic personal information. The interviewer has recorded the time that participants got into the dental hospital profile page in three selected websites and asked participants which websites they preferred.

In this system evaluation, two websites were selected to compare with the proposed system. These websites are International Medical Travel Journal (www.imtj.com) and Treatment aboard (www.treatmentbroad.com). The reason of selecting these two websites for comparison because they are promoting dental hospital in Bangkok without any advertisement of their quality in “Best Hospital Advisor” and “Medical Departure”.

9.1 Survey result

The result of system evaluation and comparison result with two existing Medical Tourism websites is shown in Table 13.

Table 13 – System review interview result.

	Participant					
Issues	**1**	**2**	**3**	**4**	**5**	**6**
Gender	Female	Male	Male	Female	Male	Male
Age Group	20-29	40-49	30-39	30-39	20-29	20-29
Annual income level	USD13k-35k	>USD100k	USD36k-55k	>USD100k	<USD12k	USD56k-75k
Nationality	Chinese	Moldovan	Swiss	French	Iraqi	Chinese
Residence	HK	Thailand	Thailand	Thailand	Thailand	China
Q1 - Website 1: International Medical Travel Journal						
Time	4mins01sec	4mins03sec	1mins54sec	3min08sec	2min25sec	3mins44sec
Search sequence	Search box → Data tags → Search box → Data tags → Search → → Filter	Search box → Search box → Search box → Data tags → Filter	Search box → Search box → Filter	Search box → Data tags → Filter box	Filter	Search box → Search box → Search box → Data tags → Search box → Filter
Enough information about hospital profile in this website?	No	No	No	No	No	No
Need to re-direct to hospital official website?	Yes	Yes	Yes	Yes	Yes	Yes
Find statistical Info?	No	No	No	No	No	No
Q2 - Website 2: Treatment Aboard						
Time	2mins27sec	2mins24sec	58sec	2mins	3min07sec	2min23sec
Search sequence	Data tags → Filter	Filter	Filter	Filter	Filter → Data tags → Filter	Filter → Filter
Enough information about hospital profile in this website?	No	No	No	No	No	No

Need to re-direct to hospital official website?	Yes	Yes	Yes	Yes	Yes	Yes
Find statistical Info?	No	No	Yes – Price list	No	No	No
Q3 - Website 3: Proposed system						
Time	27sec	24sec	13sec	12sec	20sec	26sec
Search sequence	Data tags → Filter	Data tags → Filter	Data tags → Filter	Data tags → Filter	Data tags → Filter	Data tags → Filter
Enough information about hospital profile in this website?	Yes	Yes	Yes	Yes	Yes	Yes
Need to re-direct to hospital official website?	No	No	No	No	No	No
Find statistical Info?	Yes	Yes	Yes	Yes	Yes	Yes
Q4 – Statistical info help your decision making?	Yes	Yes	Yes	Yes	Yes	Yes
Q5 – Preference?	Proposed system	Proposed system	Proposed system	Proposed system	Proposed system	Proposed system

9.2 Analysis report

Table 14 shows the reason why the proposed system is better than existing Medical Tourism website.

Table 14 – System review analysis report.

Issues	International Medical Travel Journal	Treatment Aboard	Proposed system
Targeted information retrieval time (In average)	3 mins 2 sec	2 mins 22 sec	20 sec
Search path sequence	Required different tools which are Search box, filter box, data tags' options to get to the targeted page. Some tools need to use multiple time such as entering different keywords in search box; realizing search box cannot get to hospital profile page; using other tools like filter box and data tags' options to get to the targeted page.	Having a better system to lead a user directly to filter box to search the hospital options. Filter box is not easy to use and not all the users can find the targeted page straight away. Some of the options in filter box is inefficient such as two different formats of filter box, one in pop up format and another one in website format which can slow down the information search time.	Format is easy to use and easy to understand even for the first time users. All the participants used the same search sequence to get to the targeted page. No confusing information on home page. All users can easily go straight to the hospital profile page in less than 1 minute.
Sufficient information?	No. Users need to go to Hospital official website to get more information about hospital profile.	No. Users need to go to Hospital official website to get more information about hospital profile.	Yes. Users could find all basic information, such as location map, contact number, hospital address, hospital description, doctor list, hospital accreditation, treatment list etc.
Statistical info provided?	No.	Yes but not easy to find.	Yes and easy to find.
Best option for user?	No.	No.	Yes.

9.2.1 Evaluation of processing speed

In terms of the time duration to get to the targeted page, it is very clearly showed that the proposed system is easier to use and also user-friendly. With the same instruction, all participants took much less time to reach the page that the interviewer asked for. In International Medical Travel Journal website, the average time for participants to get to the hospital profile page is 3 minutes 2 seconds while in Treatment aboard website, the average time for participants to get to the hospital profile page is 2 minutes 22 seconds. But the proposed system only required average time of 20 second to reach the page.

In the search path sequence, the result showed participants needed to use different tools or used the same tools multiple times to get to hospital profile page in International Medical Travel Journal website; even though all the users can go straight to filter box in Treatment aboard website. However, different formats of filter box slowed down user's search time. In proposed system, it showed that the result of time duration spent to get to a targeted under the condition of using the same patterns and sequence to get to targeted page is less than those of the other two compared systems, even though it was the first time for participant to try the proposed system. Table 14 shows that, in our proposed system, hospital profile search time dramatically dropped from three and two minutes to less than one minute.

9.2.2 Evaluation of decision making time

All the participants indicated statistical information is important for them in decision making. However, International Medical Travel Journal website doesn't provide any of this information to their users. Treatment aboard website has price comparison data for some of their hospitals but not all. Also it is not easy to find only one person out of six 6 who could find the price comparison page.

The proposed system has all the important statistical information in each hospital profile page and all the participants indicated the location of statistical information is easy to find. The graph format of each type of statistical information is also easy to understand and it can help them in their decision making.

CHAPTER X - CONCLUSION

Most of the described Medical Tourism websites are only able to display simple listings, words, and tables. However, the right tools such as one of the Data Mining tools namely the Association Rule, could make the Medical Tourism websites more dynamic and user-friendly.

The survey analyzed the scale of importance of different data tags. The results of survey supported the initial hypothesis that users from different backgrounds will require different types of information; while the typical websites always display the same data tags to all the viewer; and increase user retrieve information time.

The Association Rule are effective tools to match user preference with data tags' display location. However, in order to make a successful Medical Tourism website, the system should be able to integrate many other components such as data management, capacity development for learning up-to-date technique, and support of future grow, information security, regulation, risk assessment etc.

Evaluation of the proposed system showed that by adopting the Association Rule, it is effective in identifying the correlation between the user's preferences and the data tags in the Medical Tourism aggregative system. This proposed Medical Tourism aggregative system will improve Medical Tourism website user experience, advance the functionality and display data in a more personalized way, thus allowing users to faster understand what they read by graphic visualization. This will result in more users using this system, the system will gather and record all these data (user personal data and most frequent click data tags) and make the system more accurate to predict each single future user preference.

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APPENDIX

Appendix 1 - Questionnaire - Market Research

Questionnaire's outline:

Goal: Elucidate core information that foreigners expect when searching for and later deciding to undertake medical treatments in Bangkok

Objectives:

1. Determine key factors determining potential foreign patients of different age groups when they search for medical service providers in Bangkok
2. Find out what will influence the potential foreign patients of different age groups in their decision to undertake medical treatment in Bangkok
3. Assess the importance of analytical data related to objectives 1 and 2 above

Survey sections:

- Key attributes affecting customer decision
- Customer online behavior
- System outline and features, including analytical data

Questionnaire Questions and Format:

I: Personal information:

1. Gender: ☐ Male ☐ Female

2. Age Group: ☐ 20-29 ☐ 30-39 ☐ 40-49
☐ 50-59 ☐ 60-69 ☐ 70 or older

3. Annual income level:

☐ Under USD12,000 ☐ USD13,000 – 35,000

☐ USD36,000 – 55,000 ☐ USD56,000 – 75,000

☐ USD76,000 – 99,000 ☐ USD100,000 or above

4. Nationality:_____

5. Country of current residence: _____

II: About medical treatment:

6. What is the hospital that you visit most in Bangkok?_____

7. Treatment type (please choose one only):

☐ Surgery for a medical condition

☐ Cosmetic surgery

☐ Consultation and diagnostic services

☐ Transplant surgery

☐ Reproduction / Infertility

☐ Dental treatment

☐ Physical check up

8. Is this your first time undertaking medical treatment in Bangkok?

☐ Yes - Please go to question 10 ☐ No,

9. How many times in total you undertook treatment in Bangkok?

(For the purposes of this questionnaire - one treatment constitutes a set of treatments or procedures to treat one medical condition or episode of an illness)

☐ 2-5 times

☐ 6-10 times

☐ More than 11 times

10. Is this your first time undertaking treatment in the Medical Service Provider that selected in question 6?

☐ Yes - Please go to question 12

☐ No

11. How many times in total did you undertake any treatment in this Medical Service Provider?

☐ 2-5 times

☐ 6-10 times

☐ More than 11 times

II: Key characteristics that influenced your decision

12. Factors that will influence you to choose your hospital?

	Very Important	Important	Neutral	Less Important	Not Important
Professional Certifications (local and international)**	5	4	3	2	1
Medical service provider location	5	4	3	2	1
Readily available on-line Medical service provider general information – contact, profile, departments	5	4	3	2	1
Doctor profile - specialization, their educational background, years of experience	5	4	3	2	1
Pre-treatment support information (e.g. Accommodation, translator service, insurance, travel arrangement)	5	4	3	2	1
During treatment support information	5	4	3	2	1
Post treatment support information	5	4	3	2	1
Treatment costs	5	4	3	2	1
Travel costs (flight ticket, accommodation)	5	4	3	2	1
Other related cost (e.g. insurance, translator)	5	4	3	2	1

Analytical chart** for medical service providers and doctors	5	4	3	2	1
Comments about medical service providers and doctors left by other customers	5	4	3	2	1
Medical related information update (in social media, blogging, articles)	5	4	3	2	1
Search result listing tops in Search engine	5	4	3	2	1

** Certification including - Local (Thai – Ministry of Public Health) and International Standard Certification (Joint Commission International – JCI).

** Analytical charts can include Click rate in Medical Service Provider Profile page, their department, doctors profile pages; Response rate from Medical Service Provider and doctors; Price comparison; Patient experience scores chart etc.

13. Factors will make you change your hospital in your next time visit for the same treatment?)

	Very Important	Importa nt	Neutral	Less Important	Not Important
Cost	5	4	3	2	1
Location	5	4	3	2	1
Special discount / Promotion / Package deal	5	4	3	2	1
Reputation – Medical Service Provider	5	4	3	2	1
Medical Service Provider facilities and support services**	5	4	3	2	1
Reputation –	5	4	3	2	1

Doctors					
Reputation – Specific treatment	5	4	3	2	1

**Reputation means that you have a lot of information about that specific medical service provider or specific doctor or is recommended by friends, family and other doctor(s).

** Medical Service Provider support service including translators, medical concierge services, childcare center etc.

** Convenience has 2 meanings, meaning 1 (for medical tourist) is easy to travel in terms of big variety of accommodation options, cheap flights; meaning 2 (for expatriate) is close to your home or office , easy access by public transportation.

III: Customer online activities preferences

14. Which of the below social media platforms do you use the most?

(please choose one only)

☐ Facebook ☐ Twitter ☐ Linkedin

☐ Youtube

☐ Other (please specify) _____

15. Where do you usually go on-line to find the information you need about your medical treatment? (You can choose up to 3 answers)

☐ Medical service provider's website ☐ Search engine (Web browser)

☐ Word of mouth (Family / Friends) ☐ Your doctors

☐ Health / Medical Publication

☐ Others, please specify_____

16. How important is for you to be able to search treatment information that you need on the Internet?

Very Important	Important	Neutral	Less Important	Not Important
5	4	3	2	1

17. Once you decide to take the treatment outside your country of residence, how long do you think you will spend researching online?

☐ Never ☐ Few hours ☐ Few days ☐ Few weeks

☐ 1-3 months ☐ 4-6 months ☐ 7 months – 1 year ☐ More than a year

18. Have you ever use a Medical Tourism facilitator or a Medical Tourism related website?

☐ No

☐ Yes - Please specify the name/s _____

IV: Feature (Data tags) of systems used to conduct a search for your medical treatment

19. Please rate the following platforms used by you to research medical related information.

	Very Important	Important	Neutral	Less Important	Not Important
Website (Desktop, Laptop)	5	4	3	2	1
Applications (Tablet, Smart Phone)	5	4	3	2	1
Agency (by phone, email, visit in person)	5	4	3	2	1
Medical Service Provider (by phone, email, visit in person)	5	4	3	2	1

20. Please rate the importance of the following features of Medical Tourism related websites or applications?

	Very Important	Important	Neutral	Less Important	Not Important
User-friendly layout	5	4	3	2	1
Information quality	5	4	3	2	1
Analytical capability	5	4	3	2	1
Keyword search and filter box	5	4	3	2	1
Search result accuracy	5	4	3	2	1

21. If there could be one system that could provide all the information that you need when searching for a Medical service provider in Bangkok what kind of format you would prefer?

☐ Website

☐ Application

☐ Both

22. If there could be one system that could provide you with all the information that you need when searching for a Medical service provider in Bangkok for your treatment, please tell us what kind of information is most important for you?

	Very Important	Important	Neutral	Less Important	Not Important
Medical service provider location map	5	4	3	2	1
Overview of each medical service provider (Contact, address, departments, brief description, number of employee, number of doctors; comparative prices)	5	4	3	2	1
Outline the most famous departments in that particular medical service provider (For example, some hospital is famous for eye treatment, some hospital is famous for infertility treatment and some hospital is famous for cosmetic treatment)	5	4	3	2	1
Outline During and Post support information (For example, after-care service, additional rest room for accompanying family or friend, etc)	5	4	3	2	1

Analytical graphs – page view, click rate, response rate, cost comparison	5	4	3	2	1
Patient Forum – discussion on some particular disease or treatments among former and current patients	5	4	3	2	1
Related blog links – eg www.healism.com/blogs, www.implant.uk.com	5	4	3	2	1
Related articles (in terms of new technology or new treatment)	5	4	3	2	1
Outline Pre-treatment support information – accommodation, flight ticket, insurance, local tour, translator, and medical package, travel agency contact	5	4	3	2	1
News feeds in social media – Facebook, Twitter, LinkedIn, Google Talk, Line, WhatsApp, WeChat etc	5	4	3	2	1
News feed by email, e.g. eNewsletter	5	4	3	2	1
Customer service – Email, Phone number, Instant chat	5	4	3	2	1

23. What kind of statistical information (including graphs) about medical service provider you are most interested in?

	Very Important	Important	Neutral	Less Important	Not Important
Click rate (on medical service provider profile page or their website)	5	4	3	2	1
Unique visitor number (on medical service provider profile page)	5	4	3	2	1
Response rate (Frequency of the medical service provider answer the customer's questions through the system)	5	4	3	2	1
Price comparison	5	4	3	2	1
Patient experience scores chart (including overall medical service provider rating, handling patient efficiency, patient logistic management (patient cloth arrangement, meal arrangement), cleanliness, pain management, communication)	5	4	3	2	1

- END OF SURVEY -

Appendix 2 - Associate data tags – Probability (Confidence Level) – Full report

Probability	Rule
100 %	Certificate = Existing, Price comparison = Existing -> Doctor profile = Existing
100 %	Comments = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Certificate = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Hospital profile and contact = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Keyword search = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Location map = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Outline famous treatment = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Patient experience score chart = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Price comparison = Existing -> Doctor profile = Existing
100 %	Comments = Existing, Response rate = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, Certificate = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, Comments = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, Forum = Existing -> Doctor profile = Existing

100 %	During Treatment Support = Existing, Hospital profile and contact = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, Keyword search = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, Location map = Existing -> Comments = Existing
100 %	During Treatment Support = Existing, Location map = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, news update = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, Outline famous treatment = Existing -> Doctor profile = Existing
100 %	During Treatment Support = Existing, Patient experience score chart = Existing -> Doctor profile = Existing
100 %	During treatment support = Existing, Post treatment support = Existing -> Doctor profile = Existing
100 %	During treatment support = Existing, Price comparison = Existing -> Doctor profile = Existing
100 %	During treatment support = Existing, Promotion = Existing -> Doctor profile = Existing
100 %	During treatment support = Existing, Response rate = Existing -> Doctor profile = Existing
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Appendix 3 - Questionnaire – System review

I: Personal information:

1. Gender: ☐ Male ☐ Female

2. Age Group: ☐ 20-29 ☐ 30-39 ☐ 40-49
☐ 50-59 ☐ 60-69 ☐ 70 or older

3. Annual income level:

☐ Under USD12,000 ☐ USD13,000 – 35,000

☐ USD36,000 – 55,000 ☐ USD56,000 – 75,000

☐ USD76,000 – 99,000 ☐ USD100,000 or above

4. Nationality:_____

5. Country of current residence: _____

II: Time counting:

Mission: Find - Thailand / Bangkok / Dental / Any hospital / Hospital profile

1. Website 1: International Medical Travel Journal

Duration: _____

Searching sequence: _____

Questions:

1.1 When you get to hospital profile page is good enough information for you to judge this is the hospital you are looking for? Have enough required information – Location map, address, contact, hospital photo, hospital description, accreditation.

☐ Yes ☐ No

1.2 Need to go to hospital official website to get more information about the hospital profile?

☐ Yes ☐ No

1.3 Can you find any statistical information on this website that help your decision making?

☐ Yes, please specify: _____

☐ No

2. Website 2: Treatment aboard

Duration: _____

Searching sequence: _____

Questions:

2.1 When you get to hospital profile page is good enough information for you to judge this is the hospital you are looking for? Have enough required information – Location map, address, contact, hospital photo, hospital description, accreditation.

☐ Yes ☐ No

2.2 Need to go to hospital official website to get more information about the hospital profile?

☐ Yes ☐ No

2.3 Can you find any statistical information on this website that help your decision making?

☐ Yes, please specify: _____

☐ No

3. Website 3: Proposed aggregative system

Duration: _____

Searching sequence: _____

Questions:

3.1 When you get to hospital profile page is good enough information for you to judge this is the hospital you are looking for? Have enough required information – Location map, address, contact, hospital photo, hospital description, accreditation.

☐ Yes ☐ No

3.2 Need to go to hospital official website to get more information about the hospital profile?

☐ Yes ☐ No

3.3 Can you find any statistical information on this website that help your decision making?

☐ Yes, please specify: _____

☐ No

4. Do you think the statistical information could help you make better decision and faster to make a decision?

☐ Yes

☐ No

5. Which one is your preference for medical service provider information retrieval?

_____

- END OF SURVEY -

VITA

Vedrasco Man Hung Elaine was born in Fujian, China on 8 January 1978. She grew up and completed her secondary education in Hong Kong and later completed her Bachelor of Business Administration degree at the University of Canberra, Australia. She is currently studying in the M.S. in Computer Science program at the Department of Mathematics and Computer Science of Chulalongkorn University. She has over 15 years of experiences in marketing, event management and business development in Australia, Hong Kong, China, Senegal and Myanmar.