Business Intelligence Requirement Model for Health Care: A Study of Brak Hospital in Libya

Sharafaldeen Mohamed[1*], Belaid Mohammed Addokali[2], Azizah Ahmad[3], Ebrahim Ali Elburase[4]

[1]Higher Institute of Engineering Technology, Tripoli, Libya
[2]University of Tripoli, Tripoli, Libya, b.aldoukali@uot.edu.ly
[3]Universiti Utara Malaysia, Kedah, Malaysia
[4]University of Tripoli, Tripoli, Libya

[*]*Corresponding author: shraf82@yahoo.com*

Abstract:

The ever-growing nature of organizational data has been requiring the need for business intelligence tools for the purpose of decision support. In recent time, one of the organizations in the lead of experiencing data explosion is health care organizations. Data ranging from the patients' demographics, medication and diagnosis history, drug repository, medical equipment and others have been posing challenges in health care data management and data-driven decision-making processes, yet all have not been done to attend to this situation. Business Intelligence is yet to be fully employed to attend to data-driven decision-making processes in health care organizations due to insufficient requirement gathering process. This study attends to this observed problem by employing Requirement Management Control (RMC) methodology to present a BI requirement model for health care. Star-schema model was used in the presentation of data dimensions, attributes and facts elicited, negotiated and validated during the RMC phases. Diagnosis history, medication, medical supplier details, patients' demographics, drug, health insurance providers and medical practitioners' details are the elicited data needed in health care BI, with the appropriate dimensions and facts duly presented in this study. This serves as a working design document for a full-fledge implementation and development of a functional BI for health care organizations. The limitations and future works are also suggested.

Keywords: Business Intelligence, Requirement Model, Health care, decision support system

Introduction

Sound health care delivery is one of the major concerns of every country. The life expectancy: the effect of health care delivery on mortality rate of any country is directly proportional to the quality of health care delivery obtainable in such country [1],[2]. This is simply why those countries with high life expectancy are found with qualitative health care delivery. Hence, improving the quality of health care delivery is one of the utmost priorities of a responsible government [3].

As a responsible government, the Libyan Ministry of Health is working on improving the country's health care delivery, despite the great pressure due to political problems and clashes [4], generally through policy formulation

and provision of technological infrastructure. However, review of extant literatures pointed that there is still need for further strengthening the health care service [5].

BI is any methodology or technology used for the gathering, storage, analysis and access provision to data in view of supporting decision making [6]. This implies that: BI is a reliable tool in the transformation of data to useful information and explicit knowledge that can be utilized by decision makers in the health industries [7]. The essence of BI and its need by health care hospitals and centers have been further stressed by [8]. It is thus positioned that the strengthening of the health care delivery can be achieved through a well-designed BI since pragmatic usage of data to support decision making is a factor in organizational strategic headway and competitive advantage.

In order to achieve the expected result (organizational strategic headway and competitive advantage) from the adoption of BI, requirement analysis of the intending BI is essential [9]. Requirement analysis is an exercise in requirement engineering process. It centers on the identification of the functions of the technology or information system. It is opined that only a task-centered BI which is designed in line with its requirements' details will achieve the expected goals [10].

Motivation of the Study

As one of the priorities of Libyan Ministry of Health, improving Libyan's health status is given due consideration. It is believed that Libya must be a healthy country for individuals, families and the general community. And to achieve this, the health system must be equitable, affordable, and efficient and technologically appropriate (MOH, 2007). This work is essentially motivated due to the observed administrative weakness as a result of inadequate usage of the Libyan health hospitals and centers' operational data [5]. It is thus suggested that the exploration of BI will assist in the exploration of the Libya's health hospitals and centers' operational data, a critical analysis and support to data-driven and information extensive decision making in the Ministry of health. It is opined that an adequate usage of the available massive data in the health ministry will support strategic decision making, and subsequent delivery of quality health care.

Problem Statement

The growing volume of data in health organizations [11] have necessitated change in the decision-making paradigm. This is advised as a way to assist in the management and analysis of the massive data generated in the health organizations [12]. The explosive growth of health care organizations' data repositories has resulted into issues like: administrative flaws, due to not accessing the proper information, wrong medical diagnosis and un-strategic business decision [13]. For the proper utilization of the business data and operational data of the health organization, Business Intelligence (BI) is suggested for usage to actualize timely processing of the voluminous data sets.

The Brak hospital does a routine medical examination for nationals and foreigners. They engage in medical screening and attention when needed. This business activity has essentially increased the hospital operational data in terms of treatment, support, logistics, and order of entry. The data has duly been supportive to managerial decision-making activities of the hospital.

However, with the exploding growth of this data, managing its volume is becoming difficult, and making decision-supporting business analytics is becoming unachievable, therefore there is need for research that will birth BI tool through an importance phase of requirement analysis. As pointed earlier, it is established that a task-centered BI that will meet the health hospital's business decision support needs must be a product of a well-grounded requirement analysis research.

On this basis, this study answers a central question that:

How can the operational data of Brak hospital be modelled to BI so as to support the hospital's decision-making activities?

Research Questions

To answer the central problem of this study, the following are the research questions answered:

  i.   What are the operational data sources of Brak hospital?
  ii.   What are the decisions making requirements for Brak hospital?

iii. How can the Brak hospital's decision-making requirements be modelled to BI?

Research Objectives

The objectives achieved by the end of this study are:

i. To analyse the operational data of the Brak hospital.
ii. To identify the decision-making requirements for Brak hospital.
iii. To propose a BI requirement model for Brak hospital.

LITERATURE REVIEW

This section reviews related literatures to this study's statement. It discusses Business Intelligence (BI), and its framework. Also discussed are health care delivery, requirement analysis and model, and past related studies are duly reviewed.

Business Intelligence (BI)

BI is an umbrella term that encompasses the applications, methodologies, tools and databases that are harnessed for the purpose of accessing data, manipulating it and providing its analytics to business managers [14]. BI works on the functionalities and importance of data analytics. This is why BI requires historical data, or data collected from different sources for its working. BI, based on the loaded data from the databases or data warehouses do make analysis in line with its designed requirements with the sole purpose of supporting the organizational decision [15], [16].

BI is duly known as decision support system (DSS) in industries because of its main role in decision support. It has also evolved as managerial philosophy and business tool because it is utilized in the systematic process of acquiring, analyzing and disseminating information from different sources [17]. Efraim et al. [18] submitted that: DSS, Extract-Transform-Load (ETL) systems, Querying and reporting, financial reporting, Data warehouses, spread sheets, broadcasting tools, Portals, Online Application Processing (OLAP), Digital cockpits, score boards and dashboard, Data mining, Alerts and notifications, and predictive analytics are technologies, methodologies and tools that have evolved to BI over time.

Precisely, BI tools or methodologies must be flexible in terms of allowing end users to access the data repository irrespective of the data source. It must support decision making through the presentation of information and a bit of enhanced users' control. The users should be able to manipulate the data sets in line with their usage priority. Also, BI must essentially create entry for new entrants into the business world through a well-structured supply chain and business re-engineering process model [19].

Notably, because of the critical significance of BI to organizational decision making, data modelling and requirement analysis are important phases in BI framework or model. They help in the understanding of the business terms and ensures the report align with the users' queries about the data [19]. This is opined as ways of increasing the accuracy of BI, and enables developers to fully maximize the information available to them.

Business Intelligence Framework

BI framework [20] is also regarded as BI architecture [21]. It is the reference point for the development of BI solutions. The diagrammatic model points to: (1) the phases to be taken in designing BI solutions and (2) the components parts that sum to BI tool [22]. BI architecture is said to be the summation of four different components; namely: data warehouse (DW), business performance management (BPM), business analytics (BA) and a user interface.

Data warehouse aids the success of BI, especially the medium-to-large types. It houses organized and summarized historical data with the ability of allowing users to view and manipulate the data, and conform to the needed information to support business decisions. The business analytics deals with all varieties of tools that will be used in the manipulation and analysis of the data warehouse, including data mining. Business analytics in the categories of: Reporting and Queries, Advanced analytics, and Data, Text and Web Mining. These are all used for the analysis. The business performance management (BPM) is the corporate performance management of all the composing applications and tools in BI. And lastly, the user interface is the visual and graphical representation of the analyzed data (information).

6.1.2 BI Usage and Health Care Centers

The significance of quality health care is stressed by its impact on life expectancy and reduction in mortality rates [1]. This also marks the hospitality of the countries and one of her growth indices. A healthy country is a wealthy country. Hence, governments are expected to be sensitive to the health progress of their citizens. In Libya, the ministry of health is also trying the possible best towards the provision of better health care

services. However, Celik & El Taguri [5] observed, there is still much to do in the management of the institution's data for the purpose of strategic planning and competitive advantage.

With the present advancement in health informatics and adoption of electronic health usage in health care organizations, the data repository has unending stream of data [23]. It is important to note that: the health organization's operational data is the combination of the clinical and administrative data. Health care officers also rely on appropriate data business tools for befitting decision making. The growing volume of data in the health industries has adequately necessitated the usage of BI due to the fact that they need systems not only to manage data, but also to extract information to support decisions [24].

With the roles of health care organizations (HCO) in reducing costs: health care professional costs, laboratory and consumables, pharmaceutical materials, diagnosis treatment, and cost of medical intervention, analytical usage of the generated data are to be given due attention.

Decision Making in Health Care Organizations
In health care decision making, especially on social counselling of the patients, there are factors that must be considered. These factors are: the citizen's lifestyles, culture, diet, and belief. The decision-making mechanism, and the health care decision maker must consider all these factors so as to appropriately give befitting medical counselling to the patients.

Currently, the important factors that would lead to better decision-making on healthcare policies, programs and facilities provided by healthcare providers are: (1) considering the peculiarity of the patients' age, the elderly and the infant are expected to be of more priority in the provision of health services, (2) people with disabilities must considered with services tailored to their specific disability, and (3) socio-economic background, as it is related (CDoPHE, 2013).

BI Requirement Analysis and Model
Requirement engineering ensures that the tool or system under design is in alliance with the standard requirements, and in line with the expected functions of the system. It is opined that a sound requirement engineering process is a requisite to a functional and usable system [25].

The requirement analysis of the health care organization BI will deliver a model that presents a users' requirement analysis: a description of the requirement list and their corresponding priority. Then, a data mart model is presented with its fact table explanation.

Past Related Studies
Muraina [26] was also on business intelligence system for UUM health care center. The main focus of the work was on the designing and developing a BI prototype, usable by health practitioners in decision making. The work, though adequately achieved its set objectives, it narrowly focused on diagnosis-related decision making. Therefore, it mainly made use of clinical data, and health history of the students and the university members of staff. Because of the work's focus on information system development, its requirement gathering was on extracts from literature, without users' study and requirement validation.

Alwan's [27] study was on requirement model. The study duly employed the requirement management study's framework to deliver its research objectives. However, its work was on data warehouse. Though, the study's framework is highly similar to that of this study, the difference in the domains of the studies signifies the major difference. While Alwan's work chose librarian and other library's personnel as its requirement validators, the study will choose the medical personnel of the institution's health center. Also, important to note is that: Alwan focused on data warehouse as a typical type of BI tool.

Bestman & Nwanyi [28] examined BI System strategies and organizational success of public hospitals in Rivers State, Nigeria. BI components in this study were established as data mining, online analytical processing, querying systems and reporting systems significantly relates to quick decision making as well as time saving. Primary data sourced from 230 medical staff. After analyzing the collected responses, Bestman & Nwanyi concluded that the hospitals lack the touch of BI, and recommended that the Federal and state must enhance the health services by implementing business intelligence scheme and providing enough funding to establish solid base of BI.

Abdullah [29] worked on business intelligence model. His work gave a general overview of the composing components of BI that match the students' data warehouse with specific focus on UUM's students. The study gives a complete data modelling approach to BI with a well-structured documentation. However, the applicability of the proposed BI model is in the data administration of the students. This is mostly usable by students' affairs departments and other students' data-focused decision-making department of the institution.

On the other hand, this study focuses on the BI requirement model for health care centers, using UUM's health center (PKU) as its domain and scope of the study. The study will re-strengthen and precisely position the requirements' analysis phase of the BI deployment study. While using requirement management control methodology, this study's interest in on BI with an objective to deliver a requirement model that is befitting and usable for all evolving technologies credited to BI.

METHODOLOGY
This section discusses the series of methods to be used in this research. The underlying research design is mentioned, and its components as it addresses the objectives of this research are duly explained.

Research Design
This study employs qualitative research paradigm. This research approach is adopted because of the exploratory nature of this study, and its appropriateness to the research questions. Survey of semi-structured interview was administered to ten (10) respondents, and their responses are subsequently analyzed using content analysis approach [30]. The ten respondents are chosen among the medical personnel's: doctors, nurses and pharmacists, with eight of the respondents from Brak Hospital. The number of the respondents for this study and the convenience sampling method align with its qualitative approach [31].

In order to precisely address the problem statement of this study, and answer its research questions, the Fabio et al. [32] requirements management control (RMC) framework is adapted. Figure (I) below depicts the research methodological framework of this study.
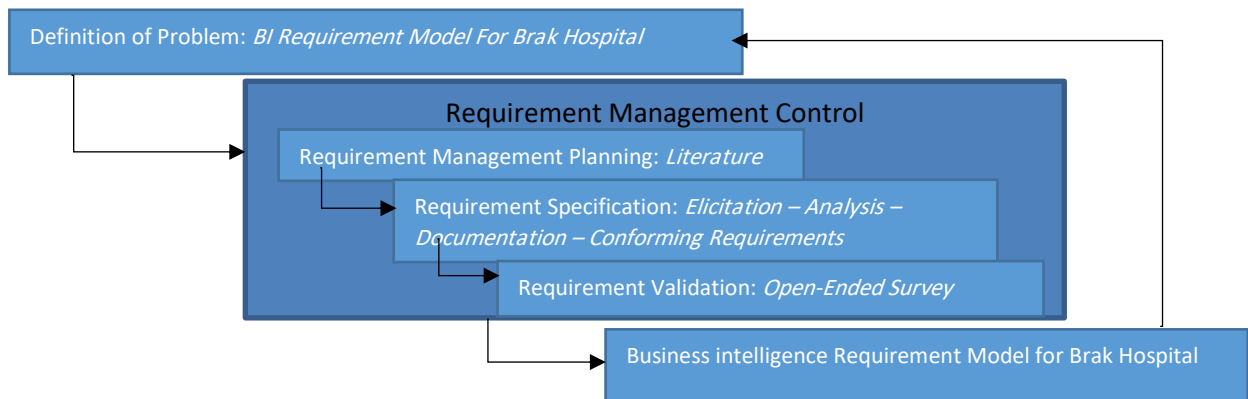

Figure I: Research Methodological Framework (Adapted Fabio et al. [32]).

Requirement Management Control (RMC) Methodology
RMC [32] is a popular adoptable methodology in requirement modelling of BI-related projects. It is primarily used in data warehousing and data mart requirement modelling. Its sophistication and comprehensiveness make it appropriate for adaptation as this study's methodology. It possesses three phases of tasks: (1) Requirement management planning, (2) Requirements' specification, and (3) Requirements validation. The Requirement Management Control implements the quality assessment of the requirement baseline as abstracted by each phase of the requirement management framework. For the specific nature of the health care BI requirements' modelling, the explanation of each of the steps involved, and the tasks to be carried out by the researcher are explained below:

Requirement Management Planning
The requirement planning stage gives the guideline for the elicitation and determination of the granularity of the data. At this stage, for proper understanding of Brak hospital's data status, critical health centers-focused literatures are reviewed and its content is analyzed in view of extracting the BI requirements from the past studies on health issues and health BI.

Requirement Specification
This phase houses iterative processes: Elicitation, Analysis and Negotiation, Documentation, and Conforming Requirements [32]. The success of the process of requirement engineering depends largely on the ability to transform informal specification (as extracted from literature review) to formal specification. Consequently, a raw data mart requirement is presented in conformity with larger BI specification. From the extract of the

literature review, the description of the BI requirements, a star-schema technique presenting the fact, measures and dimensions is presented.

For the requirements' elicitation process: related documents, literatures and health related technical papers are sampled and deeply reviewed (content analysis) to find facts and capture the requirements.

For the Requirements' analysis and negotiation stage: all the requirements gathered from the literature reviewed are checked to ensure they are valid, consistent, complete, real and verifiable. The requirements earlier extracted from literature review are checked for consistency and repetition is eliminated to avoid overlapping or redundancy.

For the Requirements' documentation stage: a complete and detailed BI requirement for the hospital must elicited and presented in an understandable manner to others. A table showing the data needed and their important dimensions is presented. This is where the star-schema BI model is done and the nexus between the data, the data dimensions and the fact table are duly presented.

For the Conforming Requirement stage, the BI requirement model as presented with the start schema model is ensured to be in conformity with the BI specification. It helps in avoiding duplication and confusion between the requirements of the entire BI model; it gives an adoptable format into the generality of BI model, and aids visual representation of the BI requirements.

Requirement Validation
The validation of the requirements specified in the above phase precisely positions the validity of the elicited requirements. The multidimensionality of the BI data mart is presented to Brak hospital's medical personnel.

Business Intelligence (Bi) Requirement Model
This section centers on the BI requirement model for Brak Hospital. All the included steps in the process of analysis and design of the health hospital's BI requirement model are done and documented using dimension table, fact table and star schema are reported. The necessary notes on requirement modelling are also given.

Requirement Definition and Analysis
This is the deliverable of the first stage of the Requirement Management Control (RMC), i.e. Requirement Management Planning. This characterizes the users' requirements analysis.
The users' requirements of the BI for the hospital are deduced from content analysis of review of related literatures as explained above. Table I shows the results of the content analysis of the literature review.

Table I: Result of Content Analysis of Related Literatures

Source	Explicit Knowledge / Requirements	Corresponding Data Needed
Zimmerman and Daley, [33]	a. To identify patients' treatment progress b. To understand patients' treatment style preferences c. To compare medical suppliers' cost of equipment or/and materials d. To monitor health insurance premium for the patients e. To manage care-cost ratio of the health centre's patients	Patient information: medication start date, medication last date, illness type, medication type, health insurance value, health insurance start date, health insurance expiry date, patients' payment detail per medication Medical suppliers' information: suppliers' company name, medical goods type, patients' opinion poll
Muraina [26]	a. To know the drug that is most consumed by the patients. b. To know the range of drugs that has their expiry date less than 3 months. c. To know the feature of most the patients that patronize the health centre	Drug name, drug identity, drug manufacturing date, drug expiry date, drug inventory: the quantity stored, quantity consumed, drug- illness compatibility, patients department, patient nationality, patients' college, patients'

	d. To know the department that has the most patronizing patients e. To know the nationality of the most patronizing patients f. To know the college of the most patronizing patients g. To discover the record of students with skin patients h. To identify the most common diseases among the patients	medication history, patient skin condition
Azizah Ahmad et al., [8]	a. To manage health care professional cost, cost of laboratory equipment and consumables, cost of treatment and cost of medical intervention. b. To manage risks during treatment c. To identify patients' treatment preference d. To manage patients' medical record	Laboratory equipment names, laboratory equipment quantity, patients' treatment history, patients' opinion poll, equipment suppliers' quotation
Bernstein [3]	a. To promote evidence-based health care delivery b. To manage health practitioners' performance through health service key performance indicators (KPI)	Patients' poll, Number of surgeries done, Number of successful surgeries, Number of complicated surgeries

In the three-column table presented above, the first column presents the references of the literature reviewed and the second column presents the explicit knowledge or the requirement. The explicit knowledge is the knowledge expected to be discovered from the health center BI so as to foster the decision making, while the requirement is possibly a function of a BI application. The third column presents the corresponding data needed, i.e., the data that fits in for a transformation that will produce the expected explicit knowledge.

From the extract of the literature review presented in table I above, the list of BI Requirements for health care center are:
1. To know the patients' diagnosis history
2. To know the patients' medication history
3. To identify patients' treatment preference
4. To manage medical materials and laboratory equipment's suppliers' information
5. To know the most quality, but cheapest suppliers' quotations
6. To know the most qualitative and cost-effective health insurance provider
7. To know the rate of drug prescription and consumption
8. To know patients' details – demographics and residential details
9. To know illness and disease frequency and rate
10. To know each of the medical practitioners' performance trend

The elicited requirements from the literatures represent the elicitation step in the requirement specification stage of the Requirement Management Control Methodology. For the analysis and negotiation step, appendix 1 is presented to the hospitals' medical practitioners to identify the priorities of the elicited requirements. The responses of the respondents are denoted with: 1 = Urgent, 2=Important, 3 = Not Important, therefore the mean value of their priority responses is computed where N is the number of the respondents. The result is presented in table II below.

Table II: Result of Requirement Analysis and Negotiation

Requirement List	Description	Priority (Mean)	N
Patients' Diagnosis History	The medical practitioners need to know about the historical trend and development of the patients' diagnosis.	2 apprx.	10

	For instance, to know if the patient is consistently diagnosed of the same ailment or of different ailment.		
Patients' Medication History	The medical practitioners need to know about the historical trend and development of the patients' medication. For instance, when a patient has been placed periodically on medication, there might be a need to check this medication history to identify the progress.	2 apprx.	10
Patients' Treatment Preference	The medical practitioners need to know the treatment preference of the patients. In cases where medical implication is not involved, some patients might prefer syrup drug to tablet, or even prefer taking injection. Knowing this preference is a way of achieving patient satisfaction index.	2 apprx.	10
Medical materials and Laboratory equipment's suppliers' information	The health care organizations need to know the details of the medical materials and laboratory equipment's laboratory information. Their companies' equity value and capital base.	2 apprx.	10
Quality, but cheapest Suppliers' quotations	The health care organizations need to be provided with the suppliers' quotation for due comparison of the different quotations, and subsequent decision affecting the choice of the supplier.	2 apprx.	10
Qualitative and cost-effective health insurance provider	The health care organizations need to know about the service provision of the health insurance companies. This is to rightly guide patients on the choice of the health insurance provider. For instance, from patients' assessment of the health insurance companies, the HCOs can safely inform the prospective clients of the health insurance company to choose.	2 apprx	10
Drug prescription and consumption	The medical practitioners need to know the historical trend and development of each patient's drug prescription and consumption. For instance, the medical practitioner needs to record the drug prescribed for each patient at every point in time so as to monitor his or her drug consumption trend.	2 apprx	10
Patients' details – demographics and residential details	The medical practitioners need have the full information about their patients' demographics (age, marital status, sex, race and religion) and their residential	2.0	10

	details. There could be instances where this information is necessary for befitting individual-based medical counselling or decision.		
Illness and disease frequency and rate	The medical practitioners need to know the most frequent disease recorded by the health center, and the rate of its occurrence. This perhaps will help in the prevention of epidemic.	2.0	10
Medical practitioners' performance trend	The management of HCOs needs to periodically investigate the performance of the employed medical practitioners. This can be done through key performance indicators' assessment or patients' opinion poll	2 apprx	10

Mean values that are approximated to 2 (apprx) are values that are more than 2.0 with < 0.5, and values that are close to 2.0 with < 0.5. From the result presented in table 4.2 above, all the requirement list are rated 2 (Important).

Furthermore, 6 open-ended survey questionnaires were distributed to radio cardiologists, pharmacists and medical doctors of the medical center. The main information provided according to the open-questions asked from the distributed survey is provided as follows:
1. Data types of Medical Decision Making: Drug prescription, patient diagnosis history, medical history demographics: age, marital status, sex and race.
2. Sources of the Data: The patient, patients' relatives
3. Medical Decision Types: drug prescription, disease/ailment pronouncement after the medical test
4. Hinderances in Data-Driven Decision-Making Process: Unavailability of medical archives and books in electronic format, unavailability of online archives on medical knowledge

Requirement Documentation & Conforming: BI Requirement Model
This is the stage in the RMC lifecycle where the BI requirements are elicited in an understandable manner to all BI professionals. This is essentially done through the presentation of dimensional tables and star-schema BI model based on the finding presented in table 4.2. After the birth of the BI model, a conforming process is done to ensure it appeals to the visual representation of BI requirements.
To achieve the above-highlighted, data definition for: patients, medical practitioner, disease, health insurance provider, drug, medication, diagnosis and medical equipment supplier are presented below.

Table III: Data Dimensional Model Definition

Data Definition	Fields
Patient	patient_id, patient_name, patient_age, patient_gender, patient_sex, patient_nationality, patient_race, patient_familycontact, patient_contactaddress, patient_contactnum, patient_medicationdetails, patient_diagnosisdetail, patient_hiptype
Medical Practitioner	Practitioner_id, practitioner_class, practitioner_name, practitioner_contactaddress, practitioner_age, practitioner_gender, practitioner_sex, practitioner_contactnum,
Disease	disease_id, disease _class, disease_name, disease_type, disease_drug
Health Insurance Provider (HIP)	Hip_name, Hip_id, Hip_class, Hip_contactnum, Hip_contactadd,

Drug	Drug_id, drug_name, drug_manfacturingdate, drug_expiringdate,
Medication	Medication_name, medication_id, medication_class, medication_patient, medication_time, medication_drug
Diagnosis	diagnosis_name, diagnosis_id, diagnosis_class, diagnosis_patient, diagosis_time, diagnosis_test
Medical Equipment Supplier (MES)	mes_name, mes_id, mes_class, mes_contactnum, mes_contactadd,

From the data dimensional model definition presented in table II, a star-schema model is designed based on the requirement analysis. The star schema has one (1) fact table and eight (8) dimension tables. The star-schema is presented in figure II.
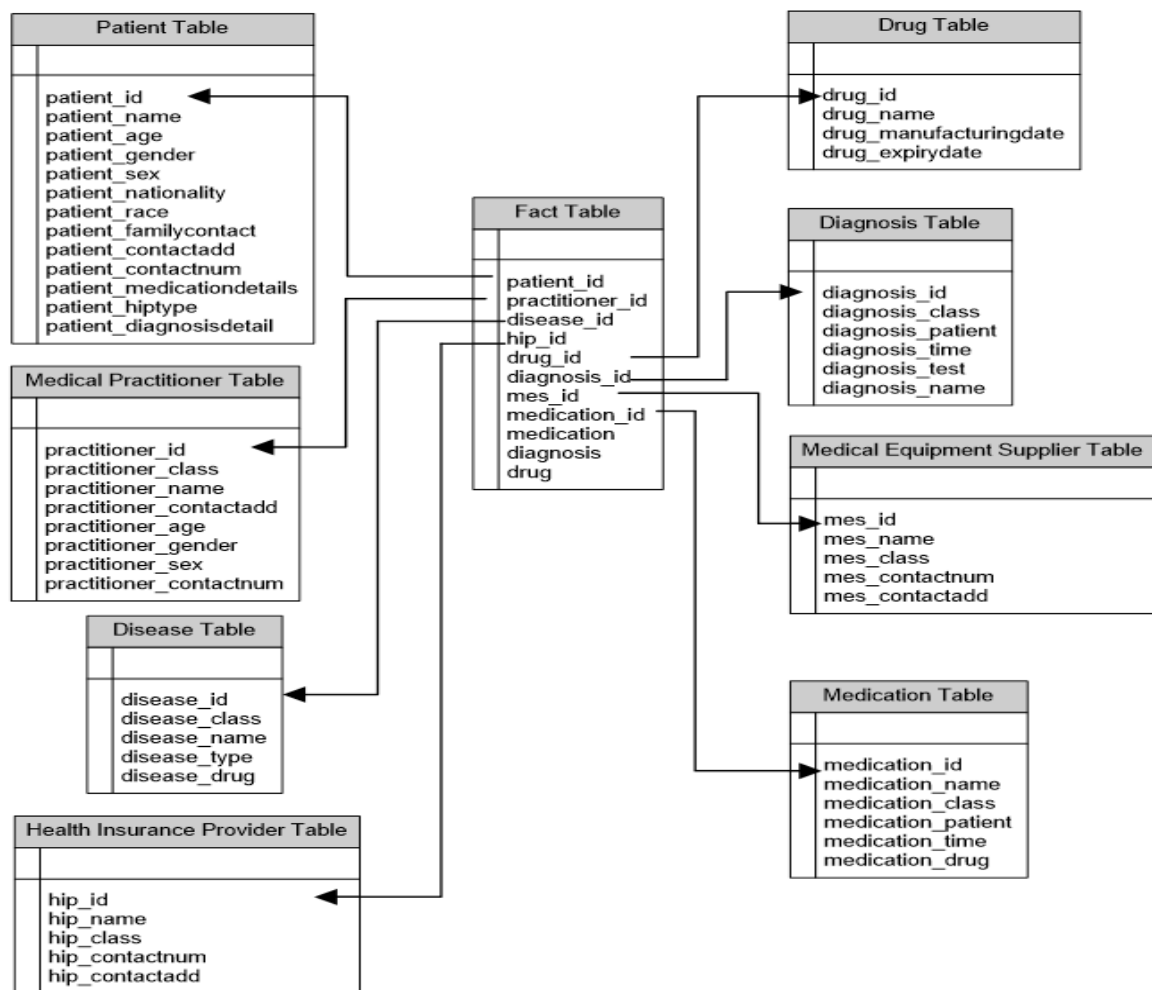

Figure II: Star-schema for Health Care BI

Figure II is the star-schema model. It is the output when star-schema technique is used in the presentation of facts, dimensions and measures of the BI requirement model. The fact table serves as the point of intersection between the specific dimension and the facts recorded. The BI requirement model is developed to meet the functionalities ascribed to the patients, medical practitioners, health insurance providers, medication and drugs as shown in the requirement negotiation and analysis. The model aids the health care management through simplification of

techniques needed for decision making processes. The BI requirement conforming stage also shows that the presented star-schema model is in conformity with the RMC standard.

Discussion

The core objective of this research is to design a requirement model for BI health care delivery. This requirement model was presented using star-schema technique. It presents the needed data, dimensions and facts needed in the design and development of health care BI. Using RMC as the requirements' gathering methodology with phases of requirement management planning, requirements specification and requirements' validation, the guidelines for the actualization of a working and functional health care BI are presented. Having followed the RMC specification as required, it is opined that the presented requirement model will assist in the health care data management processes, data-driven decision-making processes and BI development process.

Limitations and Future Works

In the cause of this study, some constraints are experienced, and these are responsible for its limitations. However, these are better served as guide for future works on the subject.

a. Due to time constraint and associated bureaucracy, the researcher could not employ the initially recommended direct field observation as part of the methods for requirement gathering. Also, a semi-structured interview was used as substitute to the initial in-depth interview. Future works should incorporate these as part of their requirement gathering methods in expectation of achieving a more grounded and rich requirements elicitation.
b. The time was too short for validation processes in terms of users' and practitioners' validity.
c. Future work could further on the development of a BI system for health care delivery by implementing the star-schema design requirement model presented by this study.

Conclusion

The benefits of decision support system and business intelligence cannot be underestimated in any organizational settings. Apart from the ease in decision making processes, they serve as sound data management tools in the present stage of data explosion. The ever-growing data repositories of organizations have necessitated the need for the employment of these varieties of data management. This study has successfully presented a road map and a working document for a realization of health care BI.

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