Expert System for Hospitals' Multi Standard Accreditation
Jordanian study

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Abstract
Accreditation is a process of evaluating business activities based upon a set of pre-determined standards [1]. Hospitals and health care centers seek international and local accreditations to win the confidence of patients and increase a competitive edge in the health services’ marketplace [11, 12]. Improvements on accreditation standards are encouraged by three parties; governments, voluntaries and independent agencies [1, 2]. Join Commission International (JCI)[ 9], and Canadian Council on Health Services Accreditation (CCHSA) 20 are two globally recognized international accreditation standards providers. Health Care Accreditation Council (HCAC) is Jordanian accreditation standards provider [18]. Hospitals and health care centers do great efforts to achieve international accreditation certificate despite the many difficulties and pitfalls awaiting them along the way. Trial and error lead to long time to success meaning escalating costs and late to gain large number of benefits of that certificate.

In this paper we propose an “Expert System for Hospitals’ Multi Standard Accreditation” that aims to walk medical users towards achieving and maintaining accreditation in most productive, efficient, and user friendly manner. To facilitate these goals the proposed system will produce large number of evaluation reports, statistics, and comparison graphics in addition to prompt and timely notifications that will be sent automatically to responsible parties about fault point for follow up procedures.

This pioneer expert system aims to provide medical professionals and organizations’ administrative staff necessary expertise in dealing with complicated information subtleties, tackled with one day to day basis, as to comply with standards and achieve this esteemed accreditation in systematic and coherent manner. What distinguishes our methodology from others is the flexibility of expert system in selecting specific standard (local or international), following up fault points, and analyzing results. The flexibility is provided to make settings for evaluation process adaptable to the selected standard, and also standard itself can be easily changed upon need. Henceforth it is suitable for both direct clients (hospitals) and indirect evaluator organization.

The proposed system will be built in multiple phases. In first phase we will take HCAC as a sample for proposed system. We use power designer to design the proposed system database entities relationships, Oracle database, Developer 6i, Report Builder and Graphics to implement the proposed expert system. All these tools are utilized under Microsoft Windows OS.

Key words. Accreditation. Health care system, Jordan, medical informatics

1. Introduction

Referring to hospital accreditation, it has been specifically defined as “A self-assessment and external peer assessment process used by health care organizations to accurately assess their level of performance in relation to established standards and to implement ways to continuously improve” [4].

There are many international hospital accreditation schemes; one of the best-known in the USA has been established by Join Commission International (JCI), it has received accreditation by the International Society for Quality in Health Care (ISQua)[5]. Accreditation by ISQua provides assurance that the standards, training and processes used by JCI to survey the performance of health care organizations meet the highest international benchmarks for accreditation entities[5].
Another prestigious scheme is owned by Accreditation Canada which was known as Canadian Council on Health Services Accreditation (CCHSA). Accreditation Canada is also certified by ISQua[6].

As a Jordanian accreditation standard, HCAC was created in December 2007, having on its Board of Directors the Ministry of Health, Royal Medical Services, Private Hospital Association, university teaching hospitals and the professional healthcare syndicates and associations. In addition to these, there is representation from the communities of academia, law, business and economic sectors[18].

While JCI mission is "to continuously improve the safety and quality of care provided to the public through the provision of health care accreditation and related services that support performance improvement in health care organizations"[17]. The CCHSA mission is "Driving quality in health services through accreditation"[6]. HCAC vision is to promote continuous quality improvement and excellence in healthcare services through the philosophy and process of health care accreditation[8].

In each case the concentration is on continuous improvement of health care services, quality through following accreditation standards, thereby it can be claimed that there is a strong demand to have a methodology or scheme enabling the health care centers to select suitable international accreditation standard.

Hospitals seek international accreditation standards to win the confidence of patients, increase a competitive edge in the marketplace, lead to effective and efficient operations by professional advice, clarify the framework for organizational structure and management, and added credibility with government and third-party financiers[11,12].

The systematic approach of hospitals and health care centers to worldwide recognized standards of services' quality and performance have been proven very elusive, unless followed up closely by precise and concise automated methodology. Achieving international accreditation standards certification for health care centers opens up a wide door of potentials and opportunities; hence the health care centers are understandably keen to obtain such a Certificate despite the many difficulties and pitfalls awaiting them along the way. The international Standards are built upon the predefined set of requirements' criteria, inherently complicated by the sheer volume and incomprehensibility unless overtly simplified, which effectually creates additional problems of subordinate understanding with potential of generating new fault points, inherently aggravated by staff's lack of experience and misunderstanding of the standards themselves. Lack of a professional self evaluation process and dependence on external resources at high expenses proved time and again to be of substandard quality, since the process itself is very time consuming and should be followed up on regular basis.

There is a belief that national accreditation schemes are more practical, culture-specific, better accepted and much less costly. Relating to culture-specific acceptance; JCI and other councils adapt their standards to country-specific needs, legal, religious and cultural values and laws[21]. Since the quality of health services has direct effect on patient's health and public trust, developing and adopting accreditation is important for Jordan in different aspects: positioning Jordan amidst highly developed countries in medical field through obtaining esteemed hospital accreditation certificate, establishment of a regional center for customization of international standards to be in agreement with Arabic and Islamic traditions and culture, responsible for setting a path for neighboring countries to fully adopt those standards. Obtaining medical accreditation gives Jordan an opportunity to become a center of attraction for medical tourism. Affecting the economy directly and indirectly through granting Jordanian hospitals a highly competitive international certification, which accompanied by price competitiveness of medical treatment in Jordan versus same quality of treatment in European countries, would give great advantage to Jordanian hospitals [18,19].

Adherence to these standards nevertheless is bound to utmost precision of information presented to decision makers so corrective measures can be applied in timely and sustainable manner. Reliability of the obtained data and continuous process of its refinement is furthermore reduced by the sheer size, overt complexity, and intractability if traditional techniques of quality assurance are applied as per se.

Considering the hospitals' objectives to establish an international Accreditation Certification, there is a clear need to design and implement user friendly expert system assisting hospitals to select particular Accreditation Standard's practices, and enabling them to follow up mistakes by detecting the fault points and introducing the corrective measures[20].

The choice of Oracle’s database and front end development tools as proven enterprise technology provided both robustness and scalability suitable for different sizes, categories and scopes of medical organizations. Cultural and linguistic differences were tackled by taking special care of Expert system’s design in localized manner, and providing bilingual data entry and display (English – Arabic) as to avoid pitfalls of phonetic differences, especially in nominal fields, as well as achieving utmost user friendliness for bilingual users. Variety
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2. Related work
Many methodologies were used to help hospitals prepare to achieve accreditation certificate such as different formats of standards’ manuals both printed and electronic\textsuperscript{13}, Web based education\textsuperscript{14}, conferences and seminars, training sessions, DVDs, Booklets and CDs\textsuperscript{17}. Those methodologies are considered primitive and hard to understand and follow, since they depend on the experience of the user which is not easily quantifiable. As an example we list the flaw found in compliance software JCAHO Net-It. Designed exclusively for JCAHO standard, this software proved to be hardly expandable and modifiable to include other standards\textsuperscript{16}, baring it inflexible with today's high rate of changeability and updatability in addition to its high cost.

Our Methodology
The Expert System for Hospitals’ Multi Standard Accreditation walks medical users towards achieving and maintaining accreditation in most productive, efficient and user friendly manner. The choice of Oracle’s database and front end development tools as latest state of enterprise technology provided both robustness and scalability suitable for different sizes, categories and scopes of medical organizations. Variety of options for management reports and decision making support provide tools for systematic materialization of intangible information by gaining patients trust, giving professionals expert path to follow and increasing approval and dependence of all national and international parties on our medical institutions.

Expert system main components

1. Administration and Security Component
Taking into account security and authorization issues are of primary concerns for system administrators in mature and responsible environment so special priority has been given to facilitate this task in detailed and atomic manner. The main objective of this component is to provide administrators a user friendly means to manage users, control and monitor access to different components of expert system. Any breach of security would negatively impact the reliability and prove disastrous on validity and correctness of gathered data compromising the objectivity and jeopardizing the whole accreditation standards compliance. This component can be further divided into three parts equally important toward prioritizing security and providing easily manageable interfaces.

1.1. Users management
Expert system administrators can create and drop users, grant and revoke privileges fine tuned to specific components according to work responsibilities and based upon need to have principle. Users are divided into three types starting by system administration group who can manage subordinates granulating privileges based on functional needs, second type of users generally known as super users can use specific components and delegate other users to use these privileges, the last but not least type of users are the end users who can use only components according to the privileges approved to them from their managers (super users) according to different responsibility levels which can contain a mix of entry, update and read only actions on components.

1.2. Control and Monitor
The first type of users – administrators – have the ability to define class of activities to send SMS or email notifications that need follow up or time sensitive decision taking. Additionally administrators have the ability to monitor user activities and take corrective measures in timely manner, also users’ logins and number of password entry tries for each user is recorded for security purposes, reports and queries can be output for management so super users can have overview into activities of their subordinates.

1.3. User friendly interface

1.3.1. Log in screens
The login screens consist of username and password entry fields, predefined by administrator they require the user to enter user name and password bound to specific components and functionalities already created by administrator. Once the user successfully enters a correct user and password other validation processes are executed deciding which components this user has already been granted. In case the user failed clear informative message is displayed whether error occurred in user name or password. Number of failed attempts is limited to three tries, after which tries limitation message is displayed and user is logout completely from the system.
1.3.2. Menu Driven Navigation

The major component of user interface is menu; the menu items and sub menus are enabled or disabled according to predefined privileges and rights given to users by system administrator. User friendliness is enforced by implementation of interface clearness, self evident logical flow, online help and quick tips to assist users and clarify different concepts and functionalities as and when. Granulation and fine tuning of responsibilities granted to users is clearly shown in the scope of menu items available to users according to her working needs and super user approved authorizations.

2. Settings and Configurations Component

As a basic building block for the whole expert system this component is used to code different categories of hospital accreditation standards, along with specific processes used in different stages of survey building, scoring, reports generation, statistics gathering, analysis studies and decision support graphical output. Generally this task is performed prior to any later stages by system administrator and is considered cornerstone upon which all other components are based.

It is crucial for system administrator to understand fully the functionality needed by different users and components so to provide efficient usability of system through employment of proven and successful software engineering design concepts of functional interface binding. Configuration can be subdivided into several dependent steps for easier management and gradual building so as to simplify the work and reduce mistakes in this essential and preliminary task.

Starting point is categorization of institutions where different health care establishments are categorized into groups of relevance so specific standards can be applied correctly and any ambiguity of relevant activities cleared or removed. Next comes classification of jobs of medical employees for given institution so as to pinpoint their fields of expertise and applicable scopes of questionnaire and survey details following the principle of asking a right person a right question and reducing the points of irrelevancy and non-applicability. Related to jobs classification staff diversification is further fine grained by the factor of significance according to qualifications classifications which clarifies academic qualifications held by employees so to approve their suitability for assigned jobs. Following comes the institution classification setting where a specific institution is bound to predefined categories of institutions reflecting applicable sets of standards. In next step a sample of employees is drawn in employee classification configuration according to predefined jobs and qualifications classifications so to specify correct type of questions according to applicable standards in different kinds of surveys. In order to increase reliability of gathered data institutions may be assisted by external consultants so expert system facilitates this feature in next step of consultants’ classification records configuration. Finally the accreditation standards are assigned to institution together with all relevant aspects and details specifying a set of flexible scopes for building survey questions.

2.1. Institution Categorization

Institution categorization enables the expert system administrator to categorize the medical institution into scopes of specialties and subsequently execute activities pertained to these categorizations. This step is crucial and precision must be sought in order to guarantee later steps and standards would be reflected correctly.

Valid examples of these categories of health care centers may be public, private and training hospitals, laboratories, emergency centers, medical centers, clinics, etc.

2.2. Job Classification

Job classification used in assigning job titles to employees is expert system setting that enables the selection of suitable questions during survey and production of different reports and statistics. This classification is used by expert system in stage of survey building specifying the nature of questions that will be asked by expert system in specific areas. In many cases expert system will request selected employee’s file according to job title together with any other criteria required by applied standard and ask different questions according to the survey target and selected algorithm.

2.3. Qualifications Classification

Employees’ academic qualifications setting is utilized by expert system as a criterion for type of selected questions according to selected standard and algorithm. Together with jobs classification this setting is used to improve the relevance of surveys building, scoring, output results, generated reports, gathered statistics and deduced analysis results according to qualifications.

2.4. Institution Classification

This setting binds the medical institution to its main category. It primarily helps in selecting the
institution’s requested accreditation standard and imposing the limits of scope to its historical transactions which are to be included in building of any future survey.

2.5. Employees Classification
Expert system uses this part to select sample of employees’ files to ask different types of questions in accordance with selected algorithm and standard in addition to selection of suitable employees to participate in self assessment survey or invoking external consultants in sharing assessment survey.

2.6. Consultants Classification.
External consultants’ component keeps records of external consultants in different fields who are candidates to participate in specific survey transactions. Additionally it produces historical transactions and notes on particular consultant. Engagement of external consultants provides a great range of expertise to improve the objectivity and validity of assessments.

2.7. Standards Classification.
Expert system uses standards component to document multiple standards for hospital accreditation featured bilingually in Arabic and English. First part\(^1\) defines the selected standard, second\(^2\) is for cluster, third\(^3\) for standard indicator, survey and scoring, fourth part\(^4\) is for sub indicator, its survey and scoring, cluster related subparts are the cluster objectives\(^5\) and cluster required documents\(^6\).

Any of above parts is linked to expert system’s original standards’ manual in case it is available in manual or its image in case of forms.

Expert system uses this part in many activities for instance:
- Gives the hospital requesting accreditation standard the flexibility to define the scope of self assessment transactions.
- Builds survey questions according to selected scope, standard and question selecting algorithm.
- Gives the flexibility to update any part of standard or add new indicators, subordinators, survey, scoring or any combination of these.

3. Standards’ Questionnaire Survey Component
For data gathering purposes a standards’ related bilingual (Arabic – English) questionnaire was devised in a clear, concise and intuitive manner. The precision of predefined questions correlates directly with usefulness and reliability of obtained data and its derivatives of different reporting options hence this component is one of the most time-consuming and labor intensive operations. Practical considerations are carefully observed in providing different choices for a super user to enter various combinations and styles of questions and scoring choices.

In order to achieve a feasible way of survey building we utilize the Accreditation Standards granulation concept so to identify the main standard in relation to its super cluster and its sub standards. Therefore and after the user choose the cluster and main standard the sub standards are selected and appropriate questions are populated for each sub standard until main standard is sufficiently identified within accreditation structure.

Question relation also decides if it is about patients meaning that expert system may select patients file and ask questions about this file related to this specific sub standard. Additionally the question may be related to specific check in because the patient may check in hospital many times and for instance one of them may be surgery therefore one of questions may be related to family rights for advance agreement. The expert system user may select different types of questions about patients according to different types of criteria like cluster survey, main standard, and sub standards as well as expert selected algorithm.

If the question is related to employee this means that expert system user may select employee and ask different type of questions according to the same criteria explained above.

In some cases the system allows the client to enter notes or clarification for additional flexibility and as the need arises so to maximize the usefulness of obtained answers. It also may ask the client to scan specific document from patient or employee files and compare it with the clustered required document and decide if it is valid or not.

The evaluation method here is the stub upon which the preciseness and flexibility is built. It is possible to set the evaluation method for each question according to specific need or style of question. One method is conformity which means the answer of this question will be only confirm or not confirm, whereas if the evaluation method is points that mean expert system will give the survey builder the decision of how many points for each selected answer are given. If the evaluation method is percentage the expert system will give the survey builder ability to specify the percentage of each answer for this question. Expert system also gives the survey builder the decision of how many points will be displayed for survey.

The expert system will remind survey builder with the effect of changing evaluation method on question answers where a reset will be adopted after any change and it will display this message in middle of screen to be clearly visible. Of course the
survey builder will have the chance to agree or ignore this change.

4. Standards’ Assessment Evaluation Component

4.1. Evaluation Settings.

After all the questions for standards have been defined users are ready to perform assessment evaluation transaction in this component via friendly interface for easy navigation. Expert system requires user to input transaction date and decide if the assessment evaluation will be done by local experts, external consultants or multiple parties in sharing mode. Depending on user selection the setting button will be enabled which means that only this button should be selected.

When setting button is pressed authority screen will be displayed asking the user to input user name and password to integrate with security and check the rights if this user has been granted authority to make settings for this evaluation transaction. After authority is established the navigation will be transferred to survey scope setting where user will be asked to define the scope of evaluation transaction if it encompasses all standards, specific cluster or specific standard indicator. If (All Clusters) is not selected then the expert system will ask the user to specify which cluster or indicators are to be included into this evaluation transaction.

According to scope selection within selected standard and question selection algorithm expert system will build survey with suitable questions to measure the health care center(hospital) if it meets the hospital accreditation standard in this area or not. Subsequently the expert system will display informative message to user that settings were successfully applied and navigation will transfer directly to main interface part and setting button will be deactivated whereas start button will become activated.

4.2. Evaluation Processing.

After the start button has been pressed the navigation transfers to actual evaluation performance where user is faced with pre selected number of questions in a very straightforward manner and ability to pause or continue is given after each question.

If a specific question can contain clarification this ability is stated to user with clear notification so the answer may become more precise and useful eliminating any ambiguity that may occur within predefined multiple choice answers. In case user indeed chooses to clarify his answer then empty text area is displayed for entry that is saved in relation with answer.

Once a user finishes answering all the questions he is presented with thank you note so it is obvious that all the questions have been answered successfully.

5. Standards’ Following Component

The adherence to standards require usually some corrective actions that in term require a process of following to check the compliance and in case that previously obtained answers were not satisfactory to introduce those corrective actions and re-evaluate accordingly.

Following engulfs all tested parties whether they are patients or employees and is performed by super user or management with capability to introduce notes on specific dates so all pending issues may be gradually resolved and new evaluation should show better adherence to standards and insure compliance leading to eventual assessment success.

6. Reports Graphics Component

As a culmination of efforts and clarification to scoring and results obtained from previous components the decision makers use intuitive graphics and other forms of reports in order to obtain a clear view of status of health center regarding the position of compliance with international standards. The evaluation transaction results can be graphically compared according to different criteria like cluster, fail points, historical evaluation transaction, and different sectors like public, military and private.

7. Conclusions

In this research, we proposed the ESHMSA in order to guide hospitals management to get certificate for well-known accreditation standard as friendly as it possible in addition to following of their fault points to prevent repletion, decrease time and cost to win certificate.

We design ESHMSA and feed it with two accreditation standards, JCI as well-know international standard and HCAC local one. The results refer that ESHMSA can be used for evaluator organization as well as evaluated one. One of main advantage for evaluator organization is comparing between there survivors' evaluation and measure there evaluation distribution from average point and intersections between there question evaluation which give indicators to exaggerated of survivor or misunderstanding which refer to standard owner organization to necessary action it may be training, or modification.

Hospitals build historical learn lessons that can be invested build capacity of managements as well as employees.

Winning accreditation standard(s) certificate is the significant goal of most world hospitals, local and regional hospitals is a large target that can benefit
from advantages of ESHMSA. to achieve this remarkable requests we recommend the following

1. Develop ESHMSA to work in web based environment which is receptivity by ESHMSA design.
2. Solve copyright matter and feed ESHMSA with popular local and international accreditation standards.
3. Encourage local and regional hospitals to take advantage of ESHMSA that friendly and easily guide them to gain an accreditation standard certificate.
4. Invest the ESHMSA receptivity to work with not only hospital accreditations standards but also other medical accreditation standard fields like laboratory, pharmaceuticals, nursing...etc.

The results of applying this system to Jordan University hospital will be available at the conference time.

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