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Development and Evaluation of a Nursing Service Management and Administration Information System at District Hospital

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Abstract

The rapid development of information technology and the multiple usage of Information Systems make indisputable their appliance in all the sectors including the Nursing Service area. Information Systems that have been developed for the Nursing Service Administration are extremely useful in the processing and the categorisation of a large number of information, providing significant advantages such as information storage, information availability, information precision and reliability. In addition, the appliance of Information Systems provides important advantages in the administration of the nursing personnel's data, contributing to the improvement of the operating effectiveness of the Nursing Service. This paper describes the development and the evaluation of an Information System for the Nursing Service Administration that classifies all the information related to the nursing personnel and helps the administration to handle the appropriate nursing data. The method of Life Cycle Model was decided as the most appropriate for the development of the System, because of the important advantages that it offers. For the evaluation of our own designed system we based on the standards, which are used for evaluating Information Systems in general. The evaluation of this Information System is carried out by a survey among the undergraduate and the postgraduate students of the Nursing Department of the University of Athens and the Nursing Personnel of a number of Hospitals. Useful conclusions have been derived concerning those characteristics, which should be fulfilled by the system. Important conclusions have been also drown out concerning the dependencies of the variables under study, the future readjustments of the system, and the general perception of the newcomers in health profession towards the application of the information technology.

Keywords:

Management Information Systems, Personnel Staffing and Scheduling Information Systems, Nursing Personnel, Hospital Nursing Staff.

Introduction

The Nursing Service, in order to ensure the delivery of high quality care, advanced clinical research, appropriate nursing sector organisation, and adequate human resources, needs a large number of information related to nursing personnel and patient needs. Thus, the key for effective administration and management of the Nursing Service of a Hospital, is the availability of reliable, valid, and qualitative information. This fact predicates the existence and appliance of Nursing Information Systems, and makes indisputable their superiority against the manual procedure [1,2]. Information Systems that are developed for the Nursing Service have been defined as the combination of Computer Science, Information Science and Nursing Science, and they are designed in order to contribute to the management of the nursing data, information and knowledge so as to enhance the nursing process and the delivery of care [3-8]. The usage of Information Systems for the Nursing Service is multiple. They can easily store and quickly manage the data files that include the appropriate information about the nursing personnel. This information is related to their demographic data, their education, their history in the hospital, and all the valuable information that complete their work profiles. These information systems classify the patient needs, retain the quality of the provided care and produce reports with statistical data in order to give a global view of the organisational situation to the Nursing Service [2, 9-11]. However, the Nursing Service of a Hospital receives all the necessary information without any categorisation or computerisation. This way, all the decisions that have been made are based on the experience of the Nursing Service Personnel and not on classified data that present the current situation of the organisation.

This paper describes the development of an Information System for the Nursing Service that classifies all the information about the nursing personnel, and helps the administration to handle, quickly and easily, all the nursing data, which are related to the staffing, the education, the nursing research and the qualitative health care delivery. The evaluation of that system was depended on the characteristics that must be fulfilled by all the Information Systems, which are developed for that area. For that reason, the observation of the Nursing Service process was necessary and a detailed analysis of the user needs of the personnel of the Peripheral General Hospital of Athens for Respiratory Diseases "SOTIRIA" was carried out. Valuable

information was also collected from the observation of the function of the Nursing Service of the District General Hospital of Athens "LAIKO".

Methodology

The method of the Life Cycle Model was decided as the most appropriate for the development of the proposed Information System. This method [12-15] contains the following seven distinct phases: the definition of the user needs, the analysis of the current system, the design of the new system, the codification of the new system, the acceptance and the evaluation, the implementation, and the maintenance of the new system. The most important phase of the methodology was the first one. During this phase all the necessary information and data requirements were fully clarified and identified by the user, in order to eliminate differences in their interpretation. The functions and the special characteristics of the new system were also specified. In the next phase, a detailed analysis of the current manual system was carried out. In this analysis, the natural presentation of the environment, in which the current system operates was included, and also information about its structure, its subsystems and the communications it makes within and without the organisation it belongs. In this phase were also clarified the factors that cause problems to the smooth operation of the system and were presented the problematic situations, which have been created. In the next phase the proposed system was designed in such a way as to satisfy the user needs and to face all the problems that were presented in the second stage of the methodology. The functional requirements and the imported and exported data from the Nursing Service were also identified. In the same phase, the operations of the proposed system through analytical diagrams i.e. Data Flow Diagrams (DFD) were designed, and a detailed description of the database of the system with its Entity Relationship Model (E-R) was included (Figure 1). Moreover, in this phase, the design of the User Interface of the system was completed and special emphasis was given to the electronic dialog between the system and the user, in order to ensure the user friendliness' requirements. Finally, a detailed documentation of the database files was included so as to be known all the appropriate information about the database. The system's design phase also dealt with the requirements related to the precision of the included data, their security, portability, their availability and the maintenance limitations, in order to ensure the system's regular operation. In the next phase of methodology the product that have been created during the design phase, was translated to a programme code. This code was documented in detail so as all the future changes would be carried out easily and without difficulties. The detailed examination of the produced software was completed in the phase of acceptance and evaluation of the new system. During the implementation phase, the installation of hardware and software, the user training, the manual distribution and the simultaneous operation of the new system with the old one, were carried out. Finally, the maintenance of the new system begins in the last phase of methodology, which is a very expensive but essential factor for its smooth operation.

The Nursing Service Administration has specific needs, which the new system must satisfy. These needs were collected by interviewing the personnel of the Hospital under survey and by the observation of the daily operation of its Nursing Service. Depended on these needs, the new system manages all the information that is related to the Sectors and the Departments of the Hospital. It manages the information that is related to the Shifts, the Days off and the Holidays of the nursing personnel, and it also handles the information that is related to educational programmes and all the reports, which have been produced. These reports are produced by retrieving the necessary data from the corresponding files, and they can either be modified or new ones can be created, depended on the user needs. All the information has been codified in such a way as to be unique and easily identifiable by the users. The type of each field ensures the precision of the data, since the users are not able to enter a different type of data in those fields that accept a specific one. The users receive messages whenever they need guidance. These messages appear always on the same location on the screen. A helpful and detailed manual has been also given to the users providing step by step instructions on the usage of the system.

The new system was codified using the relational database software package Personal Oracle for Windows. This tool was the most appropriate because it can be used with the most popular computer operating system the Microsoft Windows, providing the same functionality that exists in the Oracle Universal Server and the Oracle Workgroup Server that are designed for highly scalable platforms. Even though personal Oracle cannot function as a database server by supporting multiple users, it provides an excellent environment for prototyping, building all the tables, indexes, views and other database objects and then later to port them to a multi-user version [16]. Developer/2000, which is a family of Oracle Corporation tools, was used for the development of the interface of the system. By using this tool, the system forms, reports and the graphics were produced. Furthermore, Oracle Procedure Builder was used for the development, the maintenance and the testing of the software, which is written in a language named PL/SQL, and which can be executed from the Oracle database. The graphical user interface has been developed by using the "windows" technology. This technology has many advantages that make the interface friendly, comprehensible, and easy to be learned and used by the user. The interface has been developed with the menus' technology. This means that all the operations of the system are presented through different menus and the user is able to move through them and selects the one he wants. These operations can be activated with more than one different ways (by clicking a button or by selecting from a menu) so as to cover all the logical paths that could be followed by the user. All the data, which have been processed by the system, are logically classified in forms and specific keys that perform the same operations appear in the same location on the screen. All the information that is provided to the user through the different screens of the system is concise, in order to give the necessary ones without causing confusion. Finally it is worth mentioning that for the

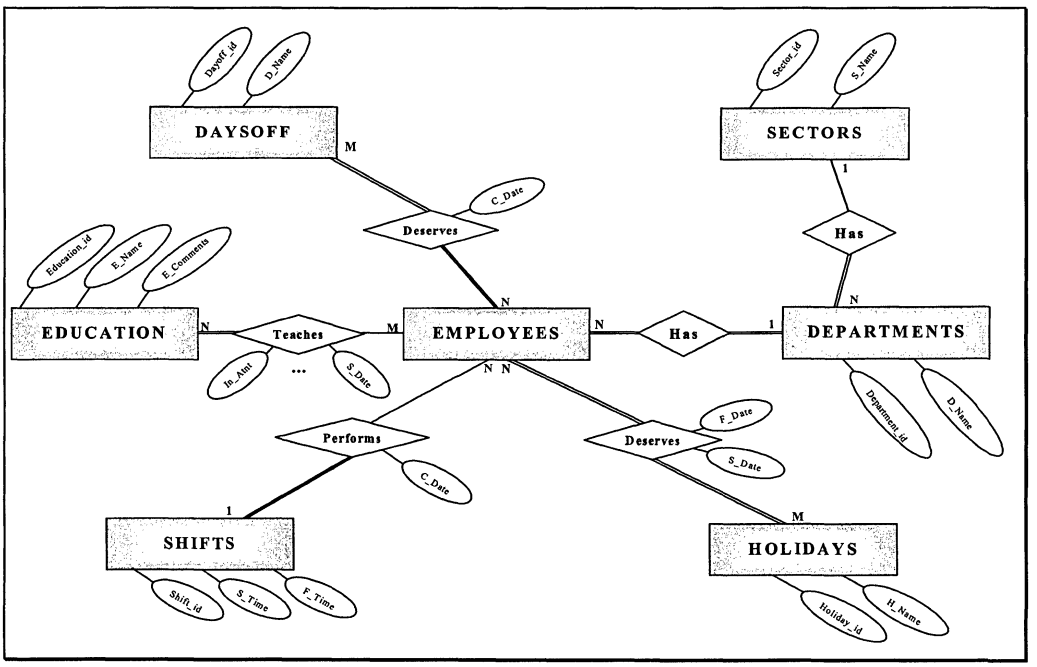

Figure 1 -The Entity Relationship (E-R) Model of the Database.

development of the code and the interface of the system specific rules were followed so as to enhance its readability, its comprehension, the debugging process, and its documentation.

Results and Conclusions

As it is already mentioned, in order to evaluate the new system a sample of 90 persons was studied. This sample includes the nursing personnel of the Nursing Service of the observed and a number of other Hospitals, and the undergraduate and postgraduate students of the University of Athens. A questionnaire was designed and distributed. The analysis of the data was performed by the statistical package SPSS for Windows (Statistical Package for Social Sciences) [17]. Firstly, the descriptive analysis of the variables took place and then the examination of the dependencies of the variables was followed. The following results and conclusions were deduced:

1. The Information System satisfies the conditions of user friendliness [18] since 94.4% of the total of the persons that have been questioned answered that the system is sufficiently-to-highly easy to learn and 96.7% answered that the system is sufficiently-to-highly easy to use. The user friendliness of a system is also determined by the electronic dialog (constructed messages) between the end-user and system [19], and by the uniformity of its appearance. The system satisfies these additional conditions of user friendliness as well, since 96.7% of the total of the persons, which have been questioned answered that the system is sufficiently-to-highly uniform in appearance and 92.2% answered that the produced messages are sufficiently-to-highly informative. These results can be explained because the user interface was developed by using the windows technology through which the user can easily interact with the software, without having any special computer knowledge. In this point, it is worth mentioning that the analytical message creation was derived by the special user needs, in parallel with the increased need of detailed guidance.
2. The Information System satisfies the conditions of security [20,21] since 95.6% of the total of the persons, which have been questioned, answered that the system is sufficiently-to-highly secure. This result can be explained because the database administrator is the only person with full access to the database of the system. He is able to create different user roles and to grant a number of privileges to each one of them. Afterwards, the administrator provides different roles to different users or to different groups of users. This way there can be users that are able only to see the data, others that are able to select them, to delete them, to create backup files and so on. In general terms, the database administrator creates so many roles, as he considers necessary for ensuring the security of the system.
3. The Information System satisfies the conditions of precision, reliability and quality [22,23] of the processed data since 97.8% of the total of the persons, which have been questioned, answered that the system satisfies these conditions sufficiently-to-highly enough. That happens because during the database

development, the relationships between its tables, and the integrity constrains are defined. The data type of every field of the database tables is also determined. This way the system neither allows the insertion of data, whose type does not comply, with the determined one, nor the deletion of related data. The user is not able to abandon unfinished operations and the system constrains his choices whenever is necessary as well. All these restrictions ensure the reliability and the quality of the data without restricting the effectiveness of the system.

4. 97.8% of the total of the questioned persons, answered that the Information System manages the data in a sufficient quick way (sufficiently-to-highly quick). Therefore, the system satisfies the conditions of promptness [24] in collecting, analysing, interpreting and correlating the data. In this point it is important to mention that the processing speed is directly related to the system hardware.
5. 97.8% of the total of the questioned persons, answered that the Information System produces appropriate reports [25] (sufficiently-to-highly appropriate) with the information efficiently organised so as to be useful to the Nursing Service. Some additional reports were asked to be produced. This happened because each hospital has different needs of information and also because the convenience, with which the new system produces the reports, increases the informational needs.
6. Finally it is important to mention that 98.8% of the total of the questioned persons believes that the Information Systems, which are developed for the Nursing Service are able to offer substantial help and also to improve the administrative effectiveness. Moreover, the 92.2% of them believe that an Information System for automated shift scheduling is able to operate effectively in the Nursing Department, despite its difficulties and functional particularities. These findings are extremely important and show that the health professionals begin to trust the new technology and to change the negative attitude towards it. Of course it should be underlined that the 50% of the persons in the studied sample has age between 20 and 29 years old. This fact means that the *new* health professionals are those who will bring the changes in the Nursing Service towards acceptance of the new technology.

During the testing of the relationship among the variables the following results were deduced:

1. The familiarity with computers is negatively related to the age of the questioned persons. That means when the age increases the familiarity decreases [26]. Furthermore, the easiness of learning and using the new system, are variables negatively related to the age. This finding means that an increase to the age causes a decrease to the easiness of the learning or using the system.
2. The easiness of using the system and the produced reports are positively related to the work situation of the questioned persons. That means the nurses compared to students: 1) consider the new system more easy to use, and 2) consider the produced reports more effective. This result can be explained because the nurses are more familiar than the students with the operation of the Hospital, so they can learn how to operate the system more easily than the students and as they are more experienced they know better which reports are more effective and helpful.
3. The familiarity with the computers and the easiness in learning the new system are positively related variables to the educational level of the nurses and students. That means when the education level increases, the familiarity with the computers and the easiness in learning the system are also increase. That happens because the postgraduate students and the nurses with higher educational level have already finished a complete educational programme and computer training courses. They also have more opportunities of participating to seminars related to the computer technology.
4. The easiness of using the system, its uniformity, and the produced reports are negatively related variables to the Hospital of the nurses. That means the nurses of the observed Hospital compared to the nurses of other hospitals, consider the system easier to use. They also consider it to be more uniform in the appearance and they are more satisfied by the produced reports. That happens because the new system was developed by using the user needs of the observed hospital and it is worth underlying that a system is considered to be successful when it satisfies the needs of the area for which was designed.
5. Finally it is very important the fact that the 40.9% of the nurses of the observed hospital answered that the system should process more data. This strange result can be explained, because is very often the phenomenon of additional user needs' creation, during the operation of the system. Some times, however, too much information can become the same harmful as too little one.

Discussion - Future changes

Through the statistical survey that carried out in order to evaluate our own Information System, we concluded that the new Information System satisfies those standards and characteristics, which are used for evaluating Information Systems in general. Thus, our own Information System satisfies the following demands: the user friendliness of the system, the uniformity of the interface, the acceptability of the produced messages, the security, the precision and the reliability of the processed data, and finally the speed of the data process. In this point it should be mentioned that in the studied sample a larger variance of ages of the questioned persons and of the years of previous experience it would be preferable to exist. That is because the attitude of the elder and more experienced nurses towards the computer technology it could be examined in a better way.

Furthermore, it is obvious that the age and the years of experience are related to each other so the study of those variables would be more accurate. During the phase of the user needs and the analysis of the current system a serious problem of description of the flow of information was observed due to the lack of familiarity of the nurses with computer technology. Some organisational problems were also observed such as unexpected changes in the schedule etc. This fact creates problems to the smooth operation of the system and makes worthless the application of the information technology. With the improvement of the computerised nursing data, the new system will provide the Nursing Service with a complete nursing profile giving to the management the global view of the personnel in order to administer it more efficiently. The creation of electronic help for the operation of the system with the technology of hypertexts would be a valuable tool to the nurses for learning the system. Finally, additional training of the nurses in computer technology through Internet or multimedia programmes could eliminate their fears and hesitations towards the new technology. In the future, when the new system would be embodied in the Hospital Information System it would become an integral part of the complete computerisation of the Hospital, having as a final scope the improvement of the quality of the health care delivery to the patients.

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