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Simulation of the Instantaneous Prediction of a Cancer Patient's Empowerment

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***Abstract*—** The purpose of this paper is to develop a decision support system based on a process of knowledge extraction. This system allows the prediction of the empowerment of a patient with cancer treated by chemotherapy. The first part of this article outlines the process of empowerment of the patient. The second part explains the principle of decision support systems and the principle of the Knowledge Discovery from Databases (KDD), inspired by the data mining method. The third section describes the approach for the implementation of the system. The fourth section applies this approach to raw data of the different patients.

***Index Term*—**Empowerment, DSS, KDD; Holon

I. INTRODUCTION

Health systems are usually organized so that professionals are at the center of patient care. However, this traditional view of the relationship between patients and their doctors is questioned at the first European Conference on empowering patients held in Copenhagen (Denmark) on the 11th and 12 th April 2012.

Originally, it was presumed that health services are involved in acute illnesses and treat them. Today, the growing need for chronic care requires the adoption of alternative approaches in this regard. Chronic diseases are the leading cause of death and disability worldwide, including cardiovascular disease, cancer, diabetes, obesity and chronic respiratory diseases.

The relationship between patient and doctor is fundamentally changing: the patient is increasingly considered an "expert" whose active participation is crucial to the decision

The autonomy of a patient is to include, among other thing, the integration of information in the process of care to enable their participation in decision making about their health [1], [2], [3]. In the spirit of using the data as "mines", are used data mining involves an automated process operating data items, which is turn belongs to a more complex which use of the data to field information usable for decision making. In other words, data mining is the most common discipline in companies seeking to extract information hidden in their databases in order to improve their processes, managing customer relationships and risk management. In recent years, the techniques of data mining have seen a considerable development in many fields of applications, particularly in the health sector. The oncology department is a hospital setting, the richest in terms of data. There is a wealth of data that is currently under exploited.

The instantaneous simulation system implementation shows the empowerment degree of a cancer patient, based on the process extraction of knowledge, allowing decision-makers to make inquiries about the degree of autonomy of a patient is necessary. Our research is situated within this context.

In this paper, we begin with a brief description of the state of art who present the basics concepts of Decision Support System **(**DSS) and Knowledge Discovery from Databases (KDD). In the second section, we describe our approach for designing and developing the DSS using KDD. In the third part, we present the realization of our DSS.

II. RELATED WORKS

Decision support system based on knowledge discovery from data consists to associate two components:

DECISION SUPPORT SYSTEMS. (D.S.S)

A. Gorry and Scott Morton defined as follows: "interactive computerized system that helps the decision maker to manipulate data and models to solve poorly structured problems" [15]. The purpose of a decision support system is to assist a decision maker, in making the available knowledge needed, to solve difficult cases. For solving some problems the decision-making process is linked to the knowledge [21].

In hospital, several decision support systems have been developed [17] [23] [12], but very few of them

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accompanied the decision maker during the entire decision-making process.

KNOWLEDGE DISCOVERY FROM DATABASES (KDD).

In order to use the data, data mining involves an automated process operating of elementary data, itself is registered into a more complex process, who data is going to information and information to decision. [13] [16].

The KDD process can be defined by a series of processes and data analyses [13], which consist of (see Fig 1):

- Describe the problem which presents the first phase where we define the objectives, the results and the means to measure the success of the data mining step.
- The research of data by combining multiple data sources in a single form. They will be selected for having the data relevant from the analysis requested.
- These data will be cleaned and transformed, to prepare it to data mining.
- In the phase of data mining, the intelligent methods of extracting information are applied. This information is interpreted and evaluated to extract knowledge.

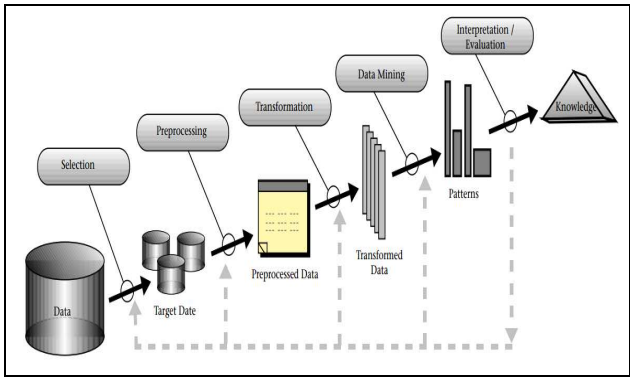

Fig 1: KDD TOOLS

DSS is an interactive and iterative process. Interactivity is linked to different choices that user is bringing round to perform. The iteratively is related to the fact that KDD occurs following a series of steps and the user can decide to go back at any time if the results do not suit him.

DECISION SUPPORT SYSTEM BASED ON A KDD PROCESS.

A DSS/KDD is a system to detect strategies for solving a decision problem via data mining [19]. In this process, the analysis of the needs of policy makers, various activities related to the preparation and handling of relevant data, as well as the integration of knowledge to help in the decision making is very important steps.

The diagram in Fig 2 illustrates the development of a DSS based on a KDD process.

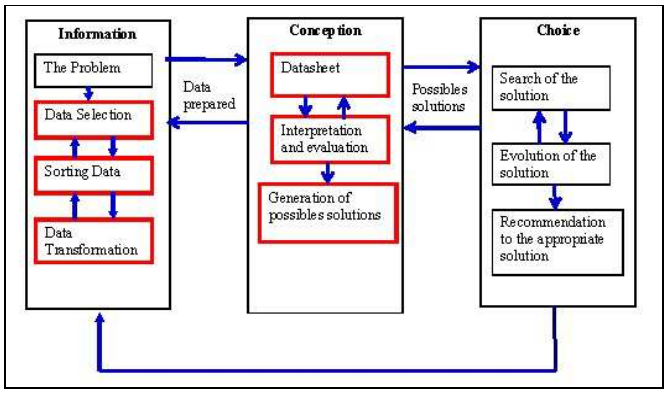

Fig 2: Process of a DSS based on a KDD

The first phase of this process is the identification of the problem, which allows identifying and defining the different main objectives of the future system. The preprocessing steps include building corpus -specific as well as to clean the data, the treatment of missing data, selection of attributes or to the selection of bodies and the processing of these data.

The second phase is data mining, which must be performed to obtain knowledge put in the form of models which must be validated.

A DSS / KDD should be interactive, as the decision maker involves the process of KDD requires of him a man-machine interaction for it to be realized. In this context, we propose a user-friendly man-machine interface to guide the future user of such a system (medical oncology service) to make the right decision at the arrival of a new cancer patient.

III. IMPORTANCE OF THE STUDY PROBLEM STATEMENT

At the time of the conference on “the universe of the patient of tomorrow; our health system in 2010”, that took place October 23 2002 to Toronto [27], lecturers evoked the patient's empowerment as the agent of change and defined 4 degrees of individual empowerment (see Fig 3).

The right to decide induces the decision's responsibility. While talking about the autonomous patient, possessor of the decision strength, we must equally reflect on the responsibility that the patient must assume.

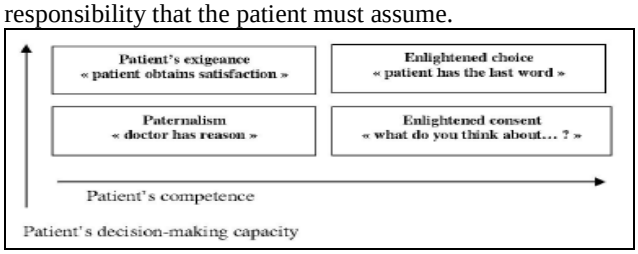

Fig 3: degrees of empowerment

Our research is based on implementation of a prediction system for a cancer patient. This system simulates the empowerment degree of a patient and to classify it in the appropriate cluster.

IV. HYPOTHESIS

System decision support based on a KDD process relies step of data mining on the case based reasoning [24]. It aims to help doctors oncology service, future users of said system via a human-machine interface, understand and predict the degree of autonomy of a patient with cancer treated with chemotherapy.

Each patient is characterized by the following variables:
Age, sex, study level, presence of family member, nurse patient dialogue, training of nurse, personal experiences, oncologist patient dialog. These characteristics will represent the exogenous variables, whereas the endogenous variable is the degree of prediction.

V. METHODOLOGY

There are several models of development in software engineering such as the waterfall model [26], V model [25] , spiral model [9] , Y model [8] or the Unified [27] . But these models are very general and human factors are not explained as the development teams of decision support systems should be encouraged to take into account.

The V-model is one of the best-known software engineering models. It structures the steps in two phases: a top-down for the design and implementation of the system, and a bottom for the integration and evaluation. The evaluation methods are defined (planned) in the downswing. This model is not specific enough to allow a perfect development of DSS and does not explicitly consider human factors. This model has often been adapted and reused in other areas.

In the field of human-machine interface, the V cycle was adapted, expanded, revised to give the U-model [4] [24] [5] [6].

In its original version, the U-model has to start placing the first steps that seemed to be fundamental in the design and evaluation of interactive systems. Over the last twenty years, it was gradually enriched by adding several steps, which are the result of research conducted in the context of several industrial projects, for example the step called "Analysis of existing" and / or "analysis of the baseline "does not exist in the original model.

This U-model is focused on man-machine interface (HMI). It seems most appropriate and meets our needs already expressed (human factors evaluation, etc.)

It is the steps that do not exist in traditional software engineering models, which remain very general, everything from the assumption that human factors should be considered by the development team. The U-model is structured in two phases

A downswing begins with a structural and functional description of the system to provide a structural framework for future activities as well as technical solutions. The result of this step is a list of tasks to be divided into automated tasks and interactive tasks (involving different degrees of collaboration between the user and the system), and then analyzed and modeled.

A rising phase focused on the evaluation of the overall system, according to criteria of efficiency of the system and also the criteria focused on the human being. Validation involves comparing the theoretical model tasks (prescribed) of the downswing with the pattern of actual activities highlighted in the ascending phase (according to the original principles proposed by [6]).

The decision support based on a KDD process system relies step of data mining on the case-based reasoning [26]. It aims to help doctors from oncology, future users of said system via a human-machine interface, to understand and predict the degree of autonomy of a patient with cancer and treated with chemotherapy

To develop our DSS based on KDD, we followed the various phases of the KDD process (Figure 1), the system was divided into modules by referring to the steps of KDD process. Three modules were designed and made: one for the storage and preparation of data, the second has been stored in a classification of four patient group (paternalism requirements of the patient, informed consent and informed choice data) using a heuristic (the k-means algorithm), and the third module for data mining itself. The search algorithm we have chosen is that of the k-nearest neighbors (kNN) used in the art of reasoning from cases.

In what follows, we describe the course of the process with respect to each of the three modules of the proposed DSS.
The objective of the first module is to develop an interface for entering different information collected during our investigation, and that can influence the degree of autonomy of a patient. The implementation of the said unit has set up a database, preprocess the data after the survey (cleaning and data transformation) and represent the data entry interface (see Fig4).

The second module has to implement the algorithm for data classification using the k-means. This classification has brought together thirty four patients interviewed grouped (cluster). Each contains patient's most similar (same degree of empowerment)

After the "Data Classification", we started the 3rd module of data mining. The initial objective of this application is to

provide the doctor a prediction on the empowerment of a patient incomer in the service (department), basing itself on the technique of the reasoning from case [30].

VI. IMPLEMENTATION

Fig 4 allows you to inter data for a new patient, modify its in case-of-error-data, delete and query the system to previously saved patient.

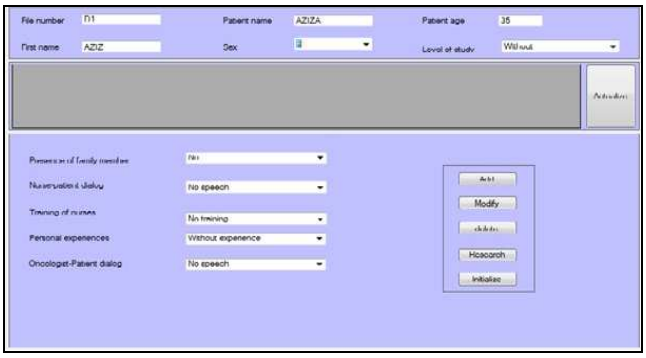

Fig 4: illustrates the case of the arrival of a new patient.

Fig 5, allows classifying all patients already registered in the four clusters, predict a new patient to assign it to the appropriate cluster.

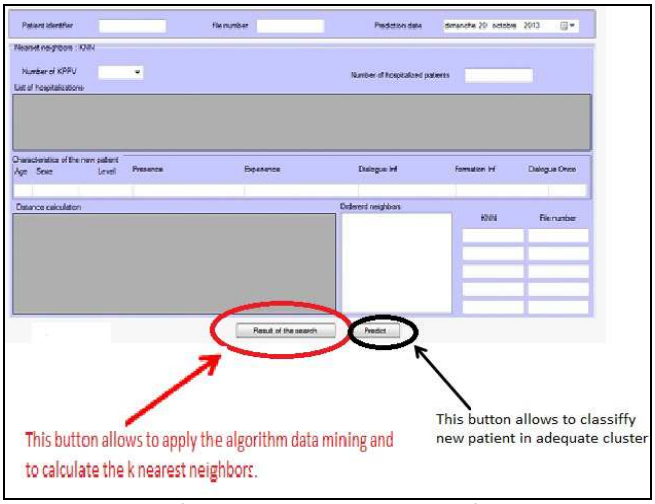

Fig 5: the classification and the prediction of a new patient

VII. CONCLUSION

This paper proposed an approach for the implementation of a system DSS using the instant decision, based on the knowledge extraction process. This DSS allows oncologists (future users of the new service), to understand (by referring to the patients history registered in the hospital database), predicted by the application of an algorithm for data mining KNN, the degree of empowerment" a new patient coming to the service. This system also allows classifying all patients historized by applying the K-means algorithm into four clusters according to their degree of empowerment: Patient's exigeance, Enlightened choice, Paternalism, Enlightened consent.

The extraction of knowledge from data (KDD) is used as a decision tool to discover, from databases, previously unknown and potentially useful knowledge for decision making.

VIII. SCOPE FOR FURTHER RESEARCH

As working prospect, the same database can be exploited to measure a set of indicators such as the number of patient step by step of empowerment, by environment, by school level and by time period of time. These indicators can be stored in a data warehouse.

To release other performance indicators, the decision support system so designed, must be subjected in a set of tests by the future users in the coming months.

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