# Data Mining and Electronic Devices applied to Quality of Life Related to Health Data

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*Abstract* — **The development of new technologies, information systems, decision support systems and clinical parameters prediction algorithms using machine learning and data mining opens a new perspective in many area of health. In this context, relevance presents the concept of Quality of Life (QOL) in health and the possibility of developing Support Systems Clinical Decision (SADC) that use it. Through individual expectation of physical well-being, psychological, mental, emotional and spiritual patients, discussed variables and measures the quality of research area of life, we intend to make a study of data to establish correlations with laboratory, pharmaceutical data , socio-economic, among others, obtaining knowledge in terms of behavioral patterns of chronic patients, achieving a number of reliable data and easily accessible, capable of enhancing the decision-making process by the specialized medical teams, seeking to improve treatments and consequently the related quality of life with the Health chronically ill. This paper studied and compared related studies that develop systems for decision support and prediction in the clinical area, with emphasis on studies in the area of quality of life.**

*Keywords – Quality of Life, Data-Mining, Support Systems Decision*

## I. INTRODUCTION

Medicine based on the evidence and consideration of the patient as a contributing factor in clinical decision making, make the evaluation questions of quality of Life Related to Health (HRQoL) becoming increasingly important.

However, the quality of life is a subjective concept usually measured through questionnaires for assessing certain aspects of quality of life (QoL) of an individual.

The multiplicity of questionnaires needed to evaluate as a whole and continuously the HRQoL of a patient and the frequency with which this assessment shall be carried out, difficult the HRQoL assessment by routine, limiting its use in support systems for clinical decision.

The electronic device is an important aid to make it simple the continuous monitoring of patients quality of life and your health status. These systems, such as blood glucose monitors, blood pressure devices, pulse oximitry devices, or heart monitors, enable medical providers to electronically observe a patient remotely using these devices and telecommunications networks and can be used alternatively to the questionnaires.

However, the basis of the quality of life assessment is self-report questionnaires that determine the perception that each patient has on you. You need to use models to relate the questions in the questionnaire with the data obtained from medical devices, replacing in part or in full the patient's responses. In fact, we do not replace the questionnaire, which will always be the basis for assessing quality of life, we want some of the issues to be determined by the data analysis models that replace reliably the individual's answers making the process simpler for him.

This study aims to show the state of the art in this area and propose some solutions for the complete and continuous assessment of HRQoL, minimizing the use of questionnaires and with low impact on the patient's routine.

In order to measure all QoL aspects its necessary use a large set of Questionnaires. It becomes tedious to administer simultaneously several questionnaires especially in patients with major limitations caused by the disease. Therefore it is essential to find alternatives, so, is essential to find alternatives,

not evasive, to replace fully or largely questionnaires, including through biometric devices or recognition that do not require the patient intervention.

At same time, is necessary to identify the HRQoL issues relevant to patients with locally recurrent rectal cancer (LCCR) with an aim to designing a new patient reported outcome measure to assess HRQoL in this cohort of patients [1]. New tools are needed for the assessment of QoL, built on the most influential factors in QoL.

## II. QUALITY OF LIFE RELATED TO HEALTH: STATE OF THE ART

### A. Definition

At present, there is no consensus in the literature on the definition of quality of life, on the specification of its underlying dimensions, and on how it should be measured, [2]. Some organizations, such as the European Commission and the World Health Organization (WHO-Quality of Life Group), consider that quality of life is a concept that has subjective components.

For the WHO, the individual's perception about their place in life depends on their cultural habits and values, and it defines the individual Quality of Life (QoL). This concept applied in the Health context is defined as: Quality of Life related to Health (QoLRH). The assessment of QoLRH is a goal in medicine, used in clinical research, in medical practice, in health related economic studies and in health management planning and strategies.

### B. Quality of life Continuous Assessment

Continuous monitoring for quality of life assessment is an important factor, especially in chronic diseases, in the prevention and early detection of symptoms and signs and consequent action, with positive effect on patient's quality of life, economic impact and resource management [3].

Quality of life has become an important issue in health care, especially in chronic diseases studies. Substantial amounts of data on quality of life are now being combined into clinical trials using a variety of instruments [3].

Routine assessment of cancer patients' HRQL had an impact on physician-patient communication and resulted in benefits for some patients, who had better HRQL and emotional functioning [4].

The continuous collection and growth of the database will allow their targeting function clinical variables identified allowing the application of the mathematical model is adjusted for more accurate and the population under study [3].

QOL is an important end point in modern day clinical practice [6]). This researcher affirms the importance of evaluation, the QOL routinely and still no differences as compared in clinical trials.

### C. Machine Learning, Data Mining and Behavior Recognition for Health Applications and QoL

A support system clinical decision (SSDC) is a set of algorithms that produce information intended to assist health professionals in decision-making. These systems have been the subject of intense study in recent decades in the field of health informatics.

Intelligent Decision Support System (IDSS), which reflected an environment demanding increasingly more complicated and faster decision-making, continued improving over time and gained additional capabilities. Currently IDSS provides decision support via text analytics and mining based DSSs; ambient intelligence and the internet of things-based DSSs; biometrics based DSSs; recommender, advisory and expert systems, data mining, data analytics, neural networks, remote sensing and their integration with decision support systems and other IDSSs.

Ambient intelligence is described as a model of interaction in which people are surrounded by intelligent devices, aware of their own presence, context sensitive and able to adapt to the user's needs through embedded technology [7]. Patient empowerment might be one key to reduce the pressure on health care systems challenged by the expected demographic changes. Knowledge based systems can, in combination with automated sensor measurements, improve the patients' ability to review their state of health and make informed decisions [8]. These sensors could be in the form of thermometers, microphones, cameras, motion sensors, or any device that can provide information to an automated control system regarding the state of the environment [9].

The progressive increase in the amount of data, information and knowledge to medical practice has been the main reason for the development of these systems. The expectation is that by providing relevant data and knowledge in health care point, the SSDC's reduce the distance between the evidence and clinical practice [10].

The volume of data generated and stored from information systems in health beyond the capacity of human analysis. In this respect Mooney and Baeziger [11] highlight the contribution of specific research in the manipulation the large volume of clinical data (biometrics data) and the implementation of bioanalytical tools able to generate knowledge for decision making. Without these mechanisms data from these systems become useless.

The purpose of including artificial intelligence is to amplify the cognitive capacities of the decision maker in the conversion of tacit knowledge into explicit knowledge. The analysis of the different variables involved will detect new relationships between the variables and new standards. This new knowledge will contribute to a better understanding of the problems.

AI technologies are often able to find important facts, patterns, relations and/or other types of new knowledge that would not have been found using standard analysis techniques such as regression [7]. The sensitivity and the decision-making consequences for health, increases the importance of systems based on artificial intelligence.

## III. PROJECT CONCEPT AND OVERALL APPROACH

This proposal is based on the following key ideas:

- User centric model for quality of life evaluation working based on medical knowledge and on the expectations of end-users;
- Holistic view of the patient promoting physical and mental well-being and social affection to maximize their Quality of Life;
- Activate feedback and quality of life estimation by encouraging and empowering patients to take responsibility;
- Non-intrusive Quality of Life estimation by means of adequate sensor devices and machine learning techniques;
- Adaptation to current needs analyzing in continuous time the patient quality of life without disturbing too much the patient;
- Adaptation to personal preferences of both healthcare professionals and patients;
- Engagement of healthcare professionals since early stages until the final evaluation.

Healthcare professionals, patients and stakeholders acceptance is essential in order to maximize the project impact and the benefits of the decision support system proposed for improving the quality of life of the patients. The project addresses this need in two ways: Firstly, a user centric development model is used where end-users and other key stakeholders will be engaged from the beginning of the project. This will include several rounds of iterative development with end-user studies that will be performed. Secondly, adaptation to the user is considered from both the point of adapting to the preferences of a user in general, as well as adapting to the current situation of the user considering the user as a holistic being with physical, psychological and social dimensions.

## IV. SYSTEM PROPOSAL

The premise in the assessment of QoL is the self-assessment, so we cannot replace the questionnaire because it is the only tool that allows you to find the self-perception.

Thus, any assessment of QoL implies to answer a questionnaire, many times a long questionnaire and in many cases more than one. For continuous and efficient monitoring a very frequent repetition of the completion of the questionnaires is necessary, mainly because of the responses have a very short shelf life (usually one week).

The minimization problem is to find a way to assign an answer to the item, without the intervention of the individual. The proposal made in this project is:

- Collect information from QOL questionnaires.

- Collect information from biometric data from the devices on the patient and / or installed (at home) for observation of the patient.
- Comparative analysis of the QoL values obtained from the questionnaire and biometric data to relate the different items of the questionnaire with biometric data
- Determine models capable of extracting information about the response to some questionnaire items based on the biometric data.

Figure 1 shows the relation between de several parts and the process to the assessment QoL with questionnaires, biometric data and clinical variables.
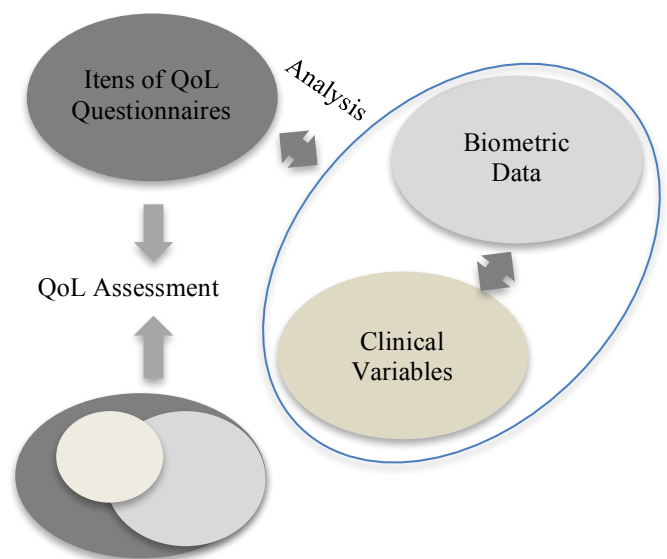


Figure 1. QoL assessment with questionnaires, biometric data and clinical variables

Currently the assessment of QoL is carried out entirely from the responses to the items of several questionnaires, often long, and tiring for the patient. As a result of this project we intend to replace the patient's response to the largest possible number of items of a particular response by the mathematical models involved.

We intend to analyse a first step what are the items of the questionnaires that can be determined by biometric data and clinical information and a second phase to replace the patient's responses to these items with the values obtained from the clinical and biometrics variables. Thus the number of items to respond will be substantially smaller and therefore less stressful for the patient.

## V. Conclusion

It is undeniable the importance of systematic assessment of quality of life in the context of health. There is much research in this field, however, there are few research projects originate later, a systematic monitoring of HRQoL.

The difficulty in the systematic application of questionnaires for measuring HRQoL, and the relationship between the cost to obtain information and the value resulting from that measurement, are some arguments that explain the non-systematic evaluation of HRQoL.

This project aims to simplify the obtaining of information on HRQoL, thereby speeding the process at the same time improving the cost/benefit of "outcomes" related to the measurement of quality of life, particularly with the introduction of devices for automatic collection a part of the information, without however withdraw the patient from the center of the process, making its more active participation in the process and providing the healthcare professional a set of tools that will help in all decision making.

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