# Care Systematization in Nursing Applying Case-based Reasoning

**Marcio Almeida Mendes[1], Rosane Oliveira Beatriz Severo[1], Sergio Takeo Kofuji[1], Ana Lucia da Silva[2], Marilza Antunes de Lemos[3]**

Laboratório de Sistemas Integráveis
Escola Politécnica da Universidade de São Paulo[1]
Nucleo de Estudos em Saúde Coletiva e da Família
Universidade Nove de Julho UNINOVE[2]
Universidade Estadual Paulista UNESP[3]

marcioam@lsi.usp.br

**Abstract**

It is very difficult to gather and seek nursing diagnoses in hospitals where clinical records are still performed manually and stored on paper forms and the adoption of computerized systems that can assist healthcare professionals in their decisions still has high cost for its acquisition and deployment. This condition makes the clinical care lengthy and often frustrates researchers by foreclosing the discovery of important information that lead to the improvement of techniques and clinical procedures. The objective of this paper is to present a software able to help nurses in their clinical reasoning, recording his experiences as a collection of cases for future research. The process involves scanning nursing diagnoses and stores them in a database of cases, thus allowing its recovery and evaluation of the effectiveness of this prototype handle cases. The presented computational tool is able to recover past experiences of health professionals, employing techniques of Case-based Reasoning whose performance was satisfactory in locating cases directly related to the test cases presented. This fact suggests that the presented prototype is able to recover diagnoses made previously and can in the future to support the decision making processes of nurses and enhancing nursing diagnoses.

## Introduction

The completion of the survey on the state of the art techniques are applied Case-Based Reasoning CBR in Care Systematization in Nursing led us to some international work, one of them was the N-CODES (Fortier 2005) that combines CBR techniques based on rules aiming to help the inexperienced nurses in decision-making using mobile technologies already FLORENCE (Bradburn 1993) which also combines CBR with rule-based techniques, when necessary, understand the diagnosis, prognosis and prescription nursing. That same research was identified in the needs of nurses have a tool to help them implement the Care Systematization in Nursing honing their techniques increasing the speed and quality of their care, without requiring costly payments for licenses to use, making it financially inviable acquisition by health institutions, public or private, especially the Brazilians, who do not have large investments in advanced technologies. Some of the goals of this work was to offer an alternative to conventional software requiring onerous licensing payments, stimulate and spread the knowledge of health professionals, stored their experiences using case-based reasoning.



## Case-based Reasoning

The Case Based Reasoning (CBR) is the technique of artificial intelligence that resembles human memory, which believes that human knowledge is recorded as road-maps situations. Likewise achieve retrieve it and run obtain the same results had been obtained previously (Kolodner 1993, Watson 1997). There are two hypotheses support the idea that reasoning: the first hypothesis refers to similar problems exist similar solutions, and the second hypothesis is that problems tend to repeat (Leake 1996). His basic philosophy is to seek a solution to the current problem by comparing the cases solved in the past. The cases can be

defined as pieces of contextual knowledge that keeps the experience total or partial resolution of a problem or a problematic situation faced in the past (Wangeinheim 2003). His characteristic process involves: identifying the current problem, seek similar experience in memory using the technique of similarity and apply the knowledge that past experience in the current problem.

**Similarity**

Is to rescue the knowledge base issues that are more useful and not necessarily identical, trying to match the description of the current problem contained and stored in case (Wangeinheim 2003), its usefulness depends on the degree of adjustment that must be made to the new solution is adopted, this requires that there be little or no adaptation of the existing solution. One way to avoid ambiguity is the correct indexing of cases which increases the possibility of finding a solution to the case investigated. Its effectiveness depends on the selection of the attributes used in cases which should be chosen considering the degree of importance able to differentiate it from other solutions less relevant. The correct indexing of cases enables the calculations of similarity and retrieval of the most suitable for the current problem.

**The similarity calculation**

A comparison between the characteristics of a given problem and the stored case, require the determination of degrees of similarity that is expressed by 0.0 (no similarity) 1.0 (equality) they are expressed in numbers, floating point, to allow calculation of similarity by part of the computer. There are two types of similarity metrics that place is the comparison with a case stored in the case base, considering the degree of similarity between the attribute values, forming a table of affinity between attributes, facilitating the adaptation of the existing solution new problem and overall similarity with regard to comparison between two objects considering all indexes. To model the overall similarity there are several techniques which calculate the similarity between cases, one of the most used is the nearest neighbor used in this study.

**OpenRBCenf**

Initially survey was conducted of the problems faced by nurses for deployment of SAE in Brazil (Mendes 2009), was later searched the solutions found in other studies that aimed to facilitate and implement the NCS in the scientific community specifically in health worldwide and alternatives Brazil this research was identified some initiatives that guided this work as N-CODE (Fortier 2005) and FLORENCE (Bradburn 1993). To make this work economically viable and meet the targets were adopted in developing the interface modules of the data acquisition and diagnostic researcher that prototype called OpenRBCenf only free tools and licensing fees and further evaluation was performed using the OpenRBCenf standards of ISO / IEC 9126.

Data Acquisition Interface

In order to provide greater interaction with the health care provider making the nursing consultation closer to reality, unlike what happens in traditional methods that only provide information, and which are often difficult to find because it is lost in the complex interfaces offered by these systems. Taking into account these factors was designed and developed a new approach based on interface technology of computer graphics, which has two principles: first to facilitate the acquisition of data and the second to become a tool to aid the learning of physiological phenomena, biological , the patient's emotional. Simulating reality through computer graphics, which allows the abstraction of various terms related to clinical problems encountered and need to be interpreted and understood.

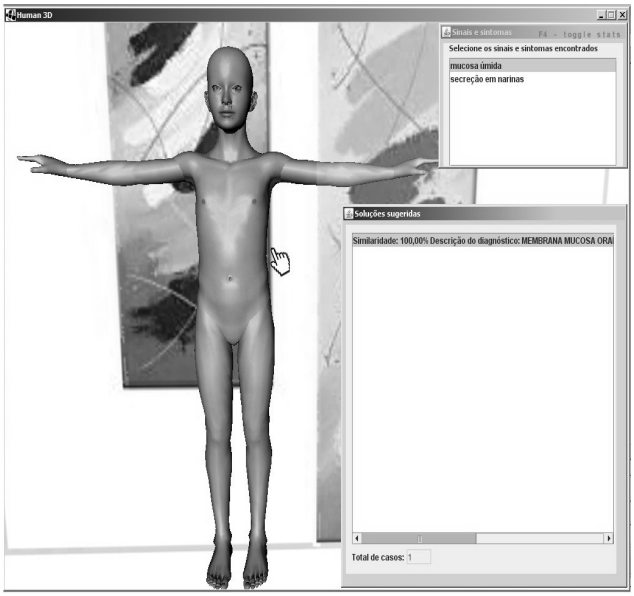
In this development tools were utilized such as:

MakeHuman is a shaper of objects in three dimensions, which specializes in creating three-dimensional models of human bodies that can simulate various characteristics such as age, weight, height, sex and even cause deformation of the model, achieving a high degree of realism;

Blender 3D modeler objects in the third dimension that was used for decomposition and export of human body parts, such as head, eyes, ears, nose, neck, trunk, arms, hands, legs etc..;

Java programming language Oracle platform used to offer compatibility with various operating systems available on the market, allowing its implementation on Linux, Windows, MacOSX, Unix, and mobile devices like PDAs, Smart Phones, mobile etc.

**Figure 1 -** Interface OpenRBCenf: Physical examination using three-dimensional human body.




**Researcher of cases**

The system OpenRBCenf has a knowledge base created with initial cases (new) reference, which were taken from the book of Nanda nursing diagnosis: definitions and classifications, work originally published under the title of North American Nursing Diagnosis Association: Definitions and Classification (Nanda 2002). The system maintains a list with hundreds of diagnosis, and periodically updated.
For classification of cases is used in the calculations basis of similarity provided by Wangeinheim (Wangeinheim 2003). The function of local similarity compares all attributes of cases stored in the knowledge base and provides a list of similarity, suggesting that the cases can be adapted to the situation, current problem, if the search for similar cases occur without success. Already the global similarity compares the attributes of the input cases with the characteristics of cases already stored in the database of cases and to effect these comparisons is used to measure overall similarity according to equation 1, where:

**Equation 1 -** Measure overall similarity

$$Sim(N,C) = \sum f(Ni,Ci) * Wi$$

N - is the new case;
C - the case in the case memory;
n - the number of attributes;
i - each attribute;
f - is the similarity function that compares the attribute of the new case i N with the base case C;
W - is the degree of importance given to the attribute.

**Search engine diagnostic**

For the development of the main phase of the researcher OpenRBCenf diagnosis (PD), which is responsible for investigating cases in the knowledge base was used jCOLIBRI framework developed by the Group for Artificial Intelligence Applications (García 2008) that provides mechanisms to retrieve, reuse, review and retain cases, and search engine researcher diagnosis was based on textual CBR module of the application jCOLIBRI jCOLIBRI, which performs case finding in a textual knowledge base. This framework supports many different types of systems RBC, and has extensive documentation and development models for CBR applications, moreover, the learning curve is lower relative to other frameworks, for example the Indiana University Case-Based Reasoning Framework (IUCBRF) (Bogaerts 2005), initially used. For this step was necessary to create an initial case base containing 17 nursing diagnoses (cases) from the book of NANDA, following the format required by the framework.

**The evaluation of openRBCenf**

Conducting the tests were based on OpenRBCenf in the categories of quality software product ABNT NBR 14598-1 and ISO / IEC 9126-1, which are edited by the Brazilian Association of Technical Standards (ABNT) and the International Organization for Standardization (ISO ) and International Electrotechnical Commission (IEC) respectively, which suggests that the characteristics and subcharacteristics software should be evaluated.
Following these criteria was developed and applied a questionnaire that can be seen at work (Mendes 2009) that possess several multiple choice questions for students of the eighth semester of the nursing program at the University Nine July (UNINOVE) and specialist nurses in pediatric oncology at the Institute of Cancer Treatment Child (ITACI), and evaluation of these two groups accounted for the target audience of the project and the evaluations is critical to project success.

**Results**

One result was the design of an interface that simulates a human body in three dimensions (3D) using computer graphics technology, facilitating the acquisition of information about the patient and stimulating learning new health professionals. The model used is a child of twelve being evaluated by means of physical examination, as can

be seen in Figure 1.

The search method of Textual Jcolibri, enabled the recovery of most similar cases as the signs and symptoms reported by the user, obtaining a mechanism capable of performing direct inference, rapidly recovering corresponding nursing diagnoses, being also possible to list all diagnoses contained in the case base. There is also a technique that enables the use internationalization by several nurses in different regions of the world, only by translating text files responsible for the content of the interface.

Held the completion of the first tests with the PD interface and in three dimensions, the next step was to integrate the two modules, creating a more pleasant environment close to reality and nurses, providing greater flexibility in the process of data acquisition and diagnostic inference bringing positive acceptance of nurses as shown in the next section.

**Evaluation**

To evaluate the two samples was separated OpenRBCenf one composed only of students completing the last year of the nursing program and another sample with nurse specialists in pediatric oncology.

Sample 1: Nursing Students

The system was evaluated and tested by students of 8th semester of nursing, who are conducting training in the outpatient UNINOVE so they can gain professional experience and thus exercise their profession. The sample consisted of nine (9) users, with four (4) males and five (5) females. Since the evaluation of the teacher responsible for these students was not computed in this sample, but in the second, as fits the profile of nursing professionals. The purpose of presenting to a group of students had two main objectives: the first is to evaluate the usability of the system for nurses with little experience and second if the tool can be used as a mechanism for learning and teaching the concepts of nursing.

Sample 2: Nurse practitioners

The system was brought to ITACI and presented to 10 health professionals to perform the tests of the prototype. The sample consisted of nurses to the age of 23 (twenty three) to 52 (fifty-two) years, all female, and four (4) Outpatient Clinic, 4 (four) of the ward, one (1) supervisor , one (1) head of nursing, both of the Office of Oncology Hematology ITACI. Noting that this sample have one (1) teacher, responsible for students of sample 1, totaling eleven (11) evaluators.

**Conclusions and contributions**

The OpenRBCenf brought several contributions to research in this direction are motivated. The main ones are:

One. The use of open source technologies and completely using open standards for this prototype reduced maintenance costs making viable the implementation of software in healthcare institutions;

2nd. The virtual model of the body in three dimensions facilitated the understanding of visible signs and symptoms, such as physiological phenomena, the biological, the psychological among others, streamlining the decision-making process;

3rd. Studies for realizing this proposal resulted in information on how to build an environment of interaction in three dimensions to health that applies concepts of artificial intelligence for diagnostic inference, material that was not found in the literature searches conducted for development;

4th. The storage of the experiences of nurses in the form of cases resulted in the ability to gather large amounts of information, which could lead to new discoveries nurses nursing diagnoses, as well as the improvement of their techniques by analyzing cases already solved.

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