A PERVASIVE APPROACH FOR INTELLIGENT DECISION SUPPORT IN CRITICAL HEALTH CARE

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Introduction

In the future, the decision-making process and the form how the people make decisions should take into account new requirements like pervasiveness, real-time and online processing. INTCare is an on-going research project involving the Intensive Care Unit of the Porto Hospital Centre whose objective is to implement an Intelligent Decision Support System (IDSS) to predict the dysfunction or failure of six organic systems and the patient outcome in order to help doctors deciding on the better treatments or procedures for the patient. The good results obtained so far motivated the transformation of this system into a pervasive IDSS. With this modification will be possible by the ICU staff access to patient information's and previsions remotely, i.e., any time any place.

This poster shows the modifications made, the requirements defined and how can it be integrated in the critical health care arena in order to improve the decision process and the Data Mining results obtained.

AIM

- ✓ Change the environment, creating a “smart environment” and make it pervasive;
- ✓ Define a new information system architecture that will be able to work in real-time, online and pervasive mode;
- ✓ Make a process dematerialization, making all process automatic and electronic as possible;
- ✓ Develop prevision Data Mining (DM) models.

Method

Change the environment and information system architecture, using the Pervasive Health Care features and ICU needs, automatize the data acquisition process, define the Data Mining System and develop / test the models / technique with the best acuity.

Results

After some interactions with ICU staff and some analyses of the environment, we defined the necessities and requirements for the ICU. We had to change several processes and reformulate the information system (IS) architecture.

The figure 1 outlines the actual reality of ICU. Like the figure shows, the environment has changed and now only some tasks are manual. Be noticed that the data validation kept manual because only the humans can see if the data associated to some patient are correct or not. For the best results, ENR, a web-based touchscreen platform, was been developed and, gives the possibility to monitor, store validate and consult, online, all data about the patient.

The figure 2 illustrates the alterations introduced, the doctors only can connect to the hospital through online applications in this case the interface will be the ENR.

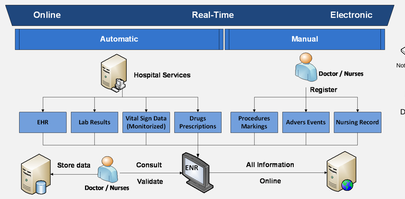

Figure 1. ICU Current Environment

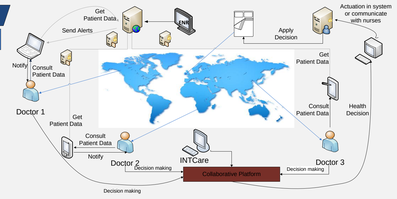

Figure 2. Hospital Pervasive Access

In order to complete the KDD process, the system attends some requirements: Online Learning; Autonomous; Real-Time; Adaptability; Safety; Accurate; Data Mining and Decision Models; Optimization; Intelligent agents; Pervasiveness; Accuracy; Privacy; Secure Access from Exterior; User Policy. Now a new information system architecture is been used by ICU, being the most important the data acquisition sub-system (figure 3). After have all data in real-time and in electronic format the DM system was designed (figure 4).

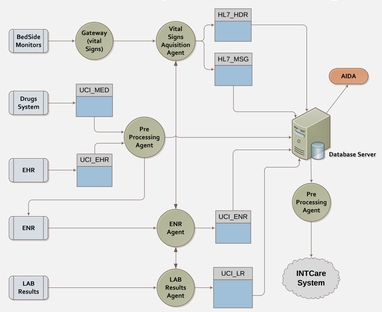

Figure 3. Data Acquisition sub-system

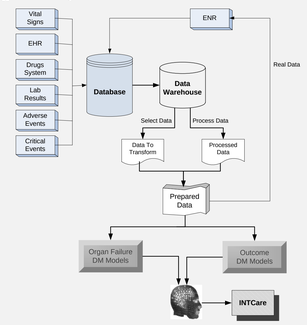

Figure 4. INTCare DM System

For each target was developed a set of 4 scenarios for some DM techniques: Artificial Neural Network (AAN), Support Vector Machine (SVM) Decision Trees, Regression and Ensembles. Table 1 sums the results and presents, for each organic system, the best scenario and the technique with the best results, in terms of sensitivity.

Target	Scenario	Sensibility	Technique
Cardiovascular	M1	93.4	ANN
Respiratory	M2	100.0	SVM
Renal	M4	100.0	SVM
Hepatic	M4	100.0	SVM
Coagulation	M2	99.8	SVM
Outcome	M1	100.0	SVM

Table 1: Best results for each target by scenario and technique

The next figure (5) shows how the entire INTCare system works remotely, valuing the DM Models continuing learning and group and mobile decisions.

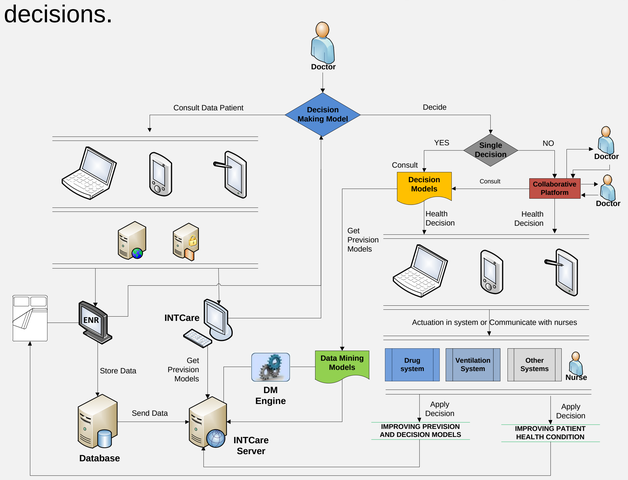

Figure 5. INTCare Pervasive system

Conclusions

The features defined and evaluated in this work made possible to transform the system in order to be more secure, robust, easily accessible and intelligent. Is expected the system will improve the patient outcome in the future due to some new facilities like the data availability in online, real-time and in electronic format. With the ICU pervasive access recast, is possible to accede to knowledge portions that can support the decision making process, anytime, anywhere.

Future Work

Define all processing and transforming task for all data collected, making it an autonomous process by the agents that execute the tasks and rules defined for each variable / source, refining the data quality. Improve the Data Mining Model and continuing the test of prevision models with real data collected in real-time and online mode. Improve the data mining scripts for critical events, ratios and medical scores automatic calculation.

Acknowledges

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