

# Web Based Nursing Management of a Cardiology Department

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## Abstract

*The system has been specifically developed to manage nursing operation of a multi ward cardiology department.*

*Main characteristics of the system are:*

- *internet access technology;*
- *data integration in the Hospital Information System by using a specific middleware;*
- *local or remote DBMS enquired by SQL.*

*The system is based on a "Client-Server" architecture referring to a centralized data base, installed on a remote Server, connected by "secure" TCP/IP network protocols. Each ward uses a standard PC Client with a specialised User Friendly Interface. Each operative client is provided by an autonomous local DB and DBMS, the data of which are automatically synchronized with the Server Dept. repository. Consultation-only clients are also foreseen.*

*ODBC access is used for handling data in both the local and remote DBs.*

*The system operates in our Institute since 1998.*

## 1. Introduction

The nursing manager system (SGIR: in Italian Sistema di Gestione Infermieristica di Reparto) has been operating at the Institute of Clinical Physiology of CNR in Pisa Italy since 1998. It allows an integrated management of most of the nursing operations within the ward activities of the hospital. The SGIR system allows to manage autonomously more than one department possibly linked to a Hospital Information System (HIS); SGIR can operate connected to the HIS by means of a specific middleware; indeed, it implements a dynamic connection between patient data and medical record, in the computer-network infrastructure, capable to integrate the different remote diagnostic and care areas (wards, laboratories, Diagnostic Areas, Care Units, etc), viewed by the system as functional areas, providing also structured information exchanged with

the HIS.

The information about therapy and the patient's biological parameters (temperature, blood pressure, heart rate,..) is available on specialised forms which are printable for nurses. The main communication characteristic of SGIR is its complete network integration by TCP/IP protocol and the corresponding Web connectivity with updated protections for data safety and security. The patient data may be consulted at nurse's stations (SI) and at a consultation station, based on desktop or wireless laptop.

SGIR architecture follows a Client-Server approach, where the client is the station directly operated by the nurses, that can also work on a local data base (synchronised with a common DB on the Server), whenever the Client -Server connection fails.

A centralized data base on a remote Server is linked by "secure" TCP/IP links to Clients (standard PC) at the wards and is operated through a simple User Friendly Interface operating through the internet protocol.

ODBC access has been used for handling data in both the local and remote DBs. Once the client is given an account, the system software can be easily downloaded through the web from a remote server, while the central server can be used as the Department's temporary repository. The software made available will also provide tools for simple graphic interfaces such as the map of beds in the ward.

## 2. Materials and methods

We developed and used the system purposely for the Cardio-Pulmonary Unit, but its architecture is applicable to any hospital department. The various clinical departments are logically referred to as clinical ward areas (CWA), in grey in Fig. 1, related to specific

clinical requirements with a proper nursing personnel; the system uses a local Intranet for data exchange as shown in Fig.1.

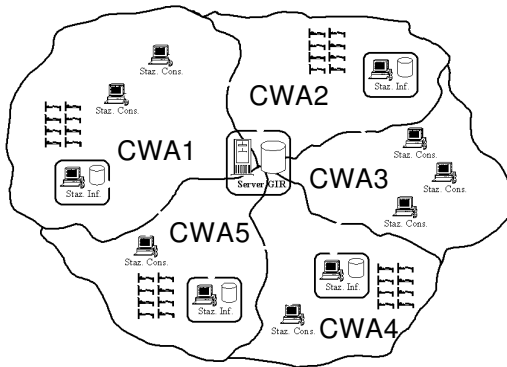


Figure 1. General Architecture of the Nursing Manager System (SGIR):

- Every CWA station foresees a PC and a special software, capable also to manage a local own Data Base;
- A Central Server (SG) constitutes the system repository of every CWA;
- There are several "Consultation Stations" available for data-retrieval only

The data handling among the various stations and the Central Server is based on the Client/Server architecture using the ODBC facilities for remote access and TCP/IP as network protocol. Some general data are usually collected by the SI on the SG:

- General data common to every CWA (ward physicians, used drugs: names and characteristics, etc.);
- Specific data of the proper CWA (anagraphical data, therapies and examinations of the CWA patients, etc).

This approach allows to update the SI common data continuously and to let each CWA access autonomously its own information. The implemented software also permits to configure all stations to access all departments information as a consultation client. Fig. 2 schematically shows this architecture.

In case of network failure or also when a net is not foreseen, the SI automatically switches all the data storage and retrieval to the local DB, allowing the regular continuous managing of the CBA. Proper synchronisation of the SG repository is automatically provided when (or if) the net communication is resumed. A pur-

posely developed middleware assures the complete integration of SGIR with the Hospital Information System (HIS); in fact, all available anagraphic information is automatically retrieved or synchronised with it, as well as all important clinical information (signals and images included) to be exchanged with any other laboratory and department in the hospital.

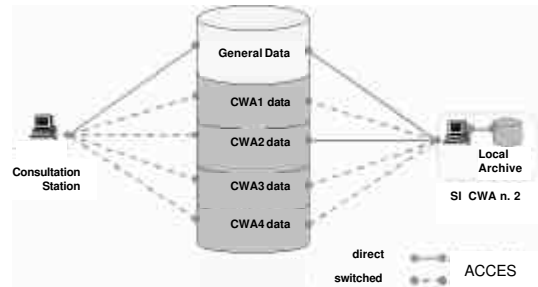


Figure 2. Data access

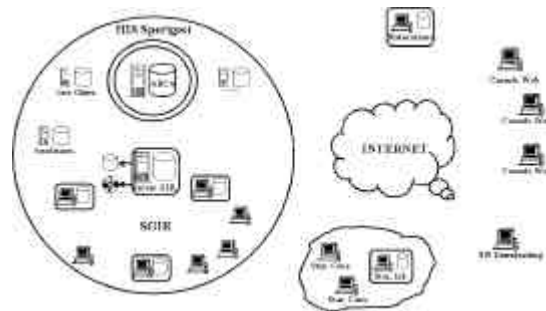


Figure 3. SGIR integration with other Informative Systems

The main operations performed by the central repository server SG, as summarized in Fig. 3, are:

- Communicating and exchanging data with the other "functional areas", namely the haemodynamic lab, the NMR lab, the Nuclear Medicine Lab, the Medical Record repository, etc (integration in the HIS);
- Exchanging data with external services, such as the meals service in charge of managing special diets;
- Communicating with other stations, possibly linked by Internet inside a VPN;
- Distributing SGIR software by Internet downloading, through authorised access account; this facility permits to simply export the SGIR system;

- Special authorised internet remote access to medi-
- Automatic storage on CD archives of any information and operation log

As mentioned before, the patient data are normally stored on both the local station archive and on the SG data base. Data safety and security are assured by various protection levels such as:

- Periodic and daily backup copies of patient data on the peripheral stations and the SG performed with the log of all transactions;
- Restriction of SI access only to authorised personnel with keyword and/or automatic signature recognition by transponder; complete exclusion to remote net access to SI;
- Securing the central repository SG access by an authorised link; the access is protected also by firewall programmes.

The main information handled by the SGIR is:

- Clinical patient information (anagraphical data, therapies, clinical measurements, diets, examinations, signals and images included, etc.);
- Patient transfers between CBAs (including an archive of discharged patients);
- An accurate record of the use, management and storage of drugs within the department;
- Each patient's diet control and the corresponding transactions with the external meal delivery service;
- All the anagraphical, administrative and health information of patients;
- The clinical patient records and examinations.

The user-friendly graphic interface of each control station allows the nursing personnel to interact easily with the system; normally, one or two days of assisted training is sufficient to the nurse to assure his/her autonomous use of the system.

Reports such as the patient list, therapy timing, data monitoring etc. are locally provided at all control stations. Simple operations allow to keep track of the patient bed transfer inside the same ward or in other sections of the hospital.

The practical use of the system can be seen in the following images:



Figure 4: The Start Screen

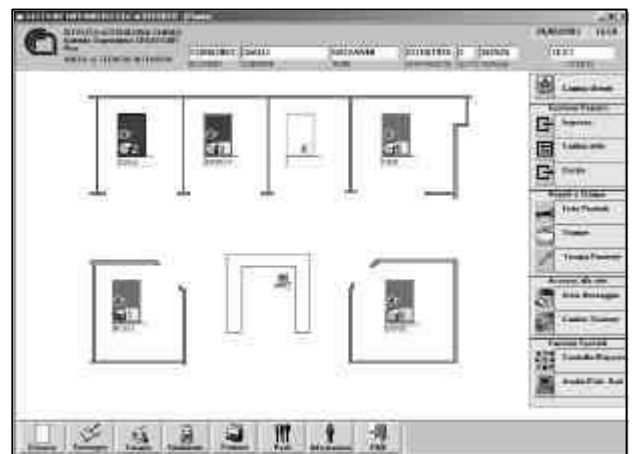


Figure 5. A Coronaric Care Unit Map

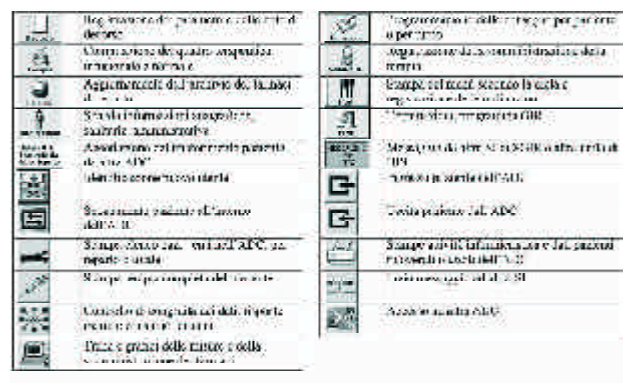


Figure 6. Icon based Menu



Figure 7. Patient incoming menu



Figure 8. Clinical Diary Menu

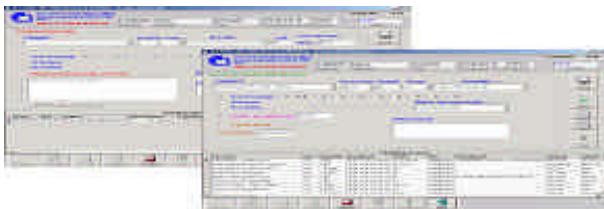


Figure 9. Therapy Menu

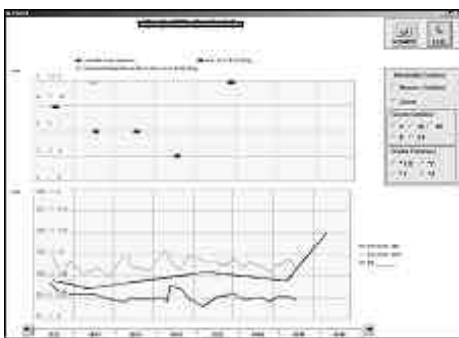


Figure 10. Example of local data processing

### 3. Discussion and results

The rising of health care costs and the need for hospital efficiency explains the usefulness of an effective clinical information system. The hospital represents a complex organization and requires the control of a multitude of different kinds of data from the management of patients to care resources. From a managerial point of view, distributing human resources effectively strictly depends on having the information on the work loads of each department available. Clinicians daily deal with a variety of data differently collected: an insufficient communication among different health professionals may generate misunderstandings and mistakes. Only an effective informative aid is able to guarantee coordinated and integrated activities in the different parts of the system. In spite of many experiences in the field, still to-day the majority of patient records are paper based and in the majority of hospitals or institutions the clinical information systems generally support only sets of clinical data.

The performance of the functions of the system is active in our Institute since 1998, has been tested, in various releases, by managing over 70 records per patient per day, corresponding to more than 4.5 millions of operations on 9233 patients in 4.5 years, and has been up to now used by over 250 nurses in 4 wards. The Italian Health Ministry has considered the system as a model of a reference product and has funded the export of the system or part of it (it has been implemented by modular software components related to specific functions) in other hospitals of the National Health System.

### References

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- [2] R Bedini, A Belardinelli, G Palagi, A. Navari, A Ripoli, V. Macellari and D. Franchi. Multifunctional Tele-Monitoring. *Proceedings of Telemedicine in Care Delivery - Technology and Application*, p. 185, Pisa, Giugno 2002

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