

# Use of Electronic Coronary Care Unit Record: Two Years Experience

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## Abstract

*In a computer - network infrastructure realized to integrate the different remote cardiovascular diagnostic laboratories Electronic Coronary Care Unit (CCU)-Record is a station dedicated to collect data derived from CCU and nurses activity. It is totally used from nurses and there is a dynamic connection between patient data and medical record. The central control station, constituted by a Pentium PC, works separately from the general archive to permit the nurses activity failing the physical link to the central system. The information about therapy and patient biological parameters (temperature, blood pressure, heart rate) are available on specialized forms which are printable for nurses necessity (therapy distribution, patient examination). From August 1999 to August of 2001 it was used to integrate data of 1500 patients recovered in a Cardiological department. The time course of blood pressure and heart rate values in hypertensive patients consented to monitorize the efficacy of treatment.*

## 1. Introduction

The rising of health care and hospital efficiency has underlined the necessity of clinical information system. Hospital represents a complex organization that requires the control of different kinds of data for the management of patients and resources. From the management point of view only the availability of a correct information about the work loads in the different units makes possible an effective distribution of the human resources. Clinicians are daily confronted with a variety of data differently collected: an insufficient communication between different professions may generate misunderstandings and mistakes. Only an effective informative aid is able to guarantee to all the staff coordinated and integrated activity in the different parts of the system. In spite of many experienced in the field, still to-day the majority of patient records are paper based and in the majority of hospitals or institution the clinical

information systems generally support only sets of clinical data.

A network-based information system was set up interconnecting the different units and health care services of the clinical departments of the CNR Institute of Clinical Physiology in Pisa, in particular cardiological and pneumological wards, and CCU (1) to achieve a transparent access to patient data, both administrative and clinical, reaching a total integration between the different sources of patient data. The resulted electronic medical record is a multimedia record collecting data coming from different databases located in remote sites, e.g. echocardiographic server, ECG system, hemodynamic lab. Electronic Coronary Care Unit (CCU)-Record was the first implemented station, to organize the nurse activity, a crucial point of the department. Nurses collect a great amount of data which have to be consulted from different personnel. They have to deal with different necessity: take care of patient first aid (personal care, meals), to monitorize vital parameters (heart rate, blood pressure, temperature), to give medicine, infusion or oral preparation, to perform daily blood samples. Moreover they have to deal with different medical doctors and to transfer information throughout many person. The system has to answer to all the personnel necessity to facilitate the work load and to organize the flow of data.

## 2. Methods

Object of the study has been the implementation and the use of CCU- Record in the two CCU and in one ward of the Institute. The design of CCU Record had to face to its daily use, focusing on the real nurses work. The first implementation of the system (2) was heavily modified with nurses suggestion, trying to standardize their procedures, adding new tables for data collection or developing new operating ways, taking care of the system ergonomic.

First of all a friendly, intuitive, graphical interface was required. Customization and condensation of data was also important: summary for review of patient data, to get both details or a global insight on the collected data were necessary. The possibility to integrate functionality with

the simpler possibility to exchange information with different group of nurses has made the system particularly useful.

## 2.1 Structure

Each CCU has a own nurse station, constituted by a Pc with the application program and local databases containing all the information and the data generated and locally needed to CCU activity. All the nurse stations are connected in local network; a common server is used for automatic backup copies, to log the activity trace, to show CCU reports on the web, interface with the hospital kitchen for the patient's meals. In such a way every station might to access as client to a remote database or other nurse station. Besides each nurse station is connected to the general archive continuously monitoring the nurses activity and exchanging data with it. This model allows to operate separately from the general archive to avoid the failing physical link, then assuring a continuously nurse activity. A background software deal with the synchronization of both the archives.

Following the selection of patient, in one page the principal functions are reported: specialized frames are devoted to parameters inputs or drugs selection and therapy plan (Fig 2)

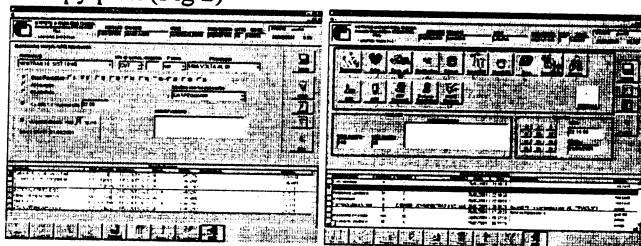


Fig.2: two specialized pages: on the left for drugs prescription and annotation; on the right for parameters input.

In each section all the principle tests or procedures more often accomplished by the personnel are listed, with any special preparation which they required and the protocol. (Fig.2).

Graphs representing the real given therapy and the time course of the biological parameters are also available in a resumng form, which are printable for nurses necessity (therapy distribution, patient examination). Moreover the reports for therapy distribution or other patient examination are available and printable.

## 3. Results

### 3.1 CCU Record

The entry point of the CCU-Record is locked by an obligatory username/password entry, to preserve patients data from undesired access and have the possibility to recognize the responsible of data insertion.

The main frame shows a map of the ward with beds exactly located as in the department differently colored in case of vacancy, male or female patient .(Fig 1).

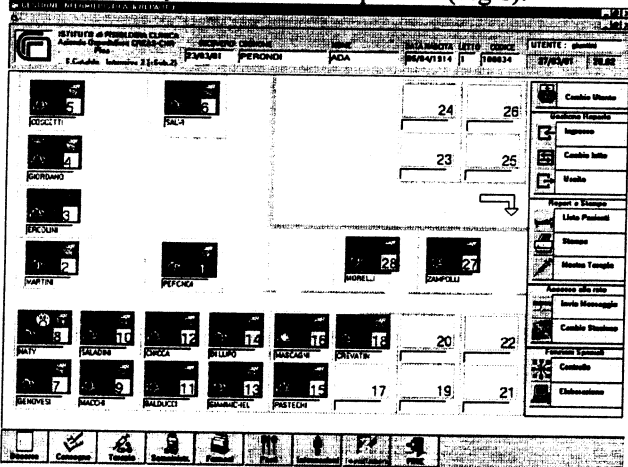


Fig. 1:the main frame of the station showing a map of the department with different colored beds and, on the right, insertion buttons

### 3.2 CCU Record application

CCU- Record is now in use for two years, since August 1999; 28 nurses have been registered as users. Initially CCU-Record was used together with conventional paper-based record, but after two months the double registration was left. The paper record which is still now products is a print of the electronic pages, which are printed at the end of daily activity to facilitate the consultation of the clinicians and for administrative purposes, been still now not completely legal the only use of electronic medical record.

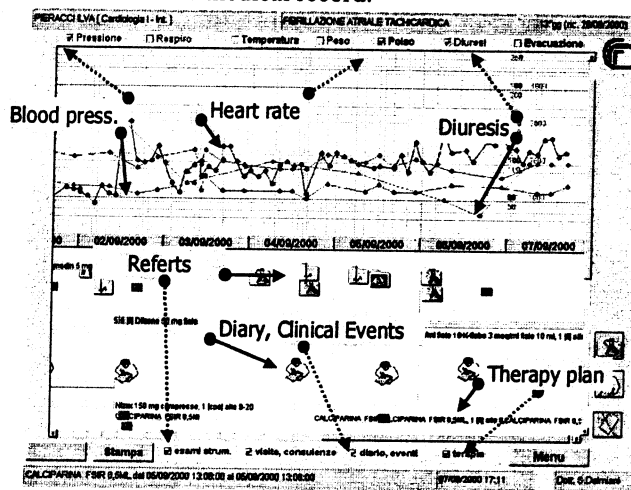


Fig. 3. Electronic medical weekly graph

In two years the data of 1500 patients were collected in the two CCU of the Cardiological department with a total of 28 beds. The parameters manually inserted from the personnel are heart rate, arterial blood pressure, temperature, respiratory frequency, diuresis, drugs administration.

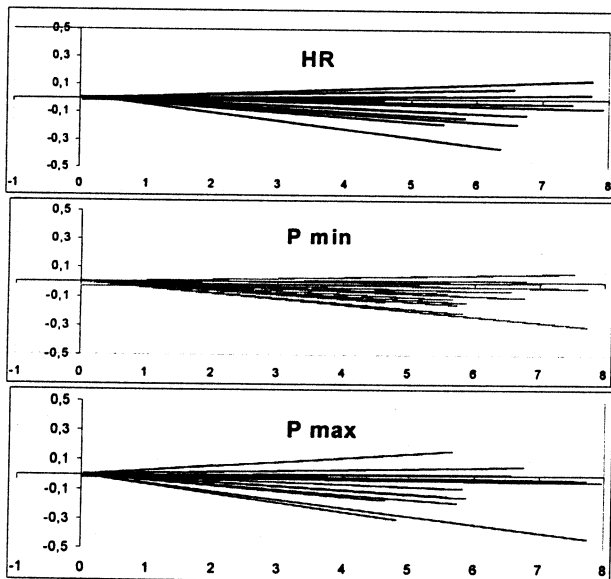
The data on therapy and biological parameters are sent to the central archive to implement the graphical page of the electronic medical record (Fig.3).

The unit generates a great amount of data, an average of 80 registration per day per patient.

From the entire population we selected 35 hypertensive patients with more of five days of hospitalization treated by antihypertensive drugs to test the capability of the system to follow the effect of drugs on heart rate and arterial blood pressure. Fig. 4 shows all patients trends: each parameter is normalized at the entrance value and it is well showed the reduction of the hemodynamic parameters during the treatment with antihypertensive drugs (beta-adrenergic antagonists, calcium channel blocking, renin-angiotensin system antagonists, nitrates). The mean values of each group of data significantly decrease at dismissal from the hospital ( $p < 0.05$ , respectively HR:0,031; P min: 0,0035; P max:0,00057; paired Student's t-test).

Finally systematic data collection consents a rapid access to quantity of drug consumption.

Fig.4: Trends of heart rate(HR), diastolic (P min) and systolic (P max) arterial blood pressure for the entire period of hospitalization ( maximum 8 days).



## 4 Discussion

The CCU-R storing all patient information allows the integration of nurses activity with other sources of data in the cardiological department. During the two years the system was daily used from all the nurses. At first there were many criticisms. The major problems concerned friendliness and efficacy of user interface, and the habit to computer use. Many criticisms were expressed on how the computer could ameliorate the job. Another problem was the time needed for data access through Intranet, timely flow of data from the functional unit into the central database and network faults. At the beginning the functional unit did not send to the central database immediately the data, with a delayed in the data vision from the medical station. Once those critical problems were solved, the advantages became evident in every-day use. The curiosity and the friendliness helped at the beginning. The system forced the medical doctors to write more precisely the prescription and any information exchanged with the staff. Many prescriptions can generate therapy errors, an insufficient communication between different professional figures may generate misunderstandings, a non correct monitoring of the drugs may take to wastes.

The system demonstrated several advantages for the activity of the nurses: a quick and safe control of work, the standardization of the procedures, an easy way to obtain printed form.

The physician is supported in the clinical evaluation of the patient by a great amount of data inserted almost on-line in the system by the direct intervention of the nurses. To obtain rapidly the hemodynamic response to drugs prescription helps to follow therapy efficacy and to interpret patient symptoms.

The efficacy of the system is based on the effective and fruitful co-operation with the nurses and the medical staff during the realization and thereafter. The final version, in addition to the true management mechanization, supplies itself the basis to associate, catalogue and quantify patient needs, interventions and results.

Moreover CCU-Record is useful to investigate the modern nursing technique focused to increase the service towards the patient and the department operative effectiveness increase. These results will be otherwise difficult to be collected without a systematical rational quantified and global monitoring of the activity

Having localized the PC in the CCU where is the hardware surveillance device for ECG monitoring a problem is a possible decreasing attention of the personnel to the ECG screen while they are using the nurses unit. Where this observation will be proved a different place of the PC with a dedicated nurse has to be prevented.

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## **References**

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