

ECG Devices Interoperability in Hospital Environment: Clinical Experience

C Carpeggiani¹, F Conforti¹, S Dalmiani¹, M Emdin¹, A Macerata²

¹CNR Institute of Clinical Physiology, Pisa

²Department of Internal Medicine, Pisa University, Italy

Abstract

The clinical use of information systems is now widely accepted in hospital departments. Among diagnostic instrumental examinations the electrocardiogram is the most popular diagnostic procedure in hospitals and out-patient points of care and its integration in Hospital Information System (HIS) is mandatory. We report our experience in integrating ECG devices in the clinical HIS of an advanced Health Care Center for pulmonary and cardiovascular disease. In the last five years the Electronic Medical Record was daily used and automatically filled, as much as possible, by diagnostic instrumentation. Electrocardiogram was the last diagnostic procedure to be integrated; this depended both by technical problems and by functional variables. Solutions adopted are the results of technical choices for an optimal integration of ECG devices into Electronic Medical Record and the guidelines and advices suggested by doctors and nurses. One year validation takes into account the real bedside process of ECG acquisition in clinical ward or laboratories, following the instrumentation requirements as expected by the users. On the basis of our experience we conclude that the commercial ECG device integration is far to be reached and it is one of the most challenge problems in a hospital environment.

1. Introduction

The rising of health care and hospital efficiency has underlined the necessity of Clinical Information Systems. Hospital represents a complex organization that requires the control of different kinds of data for the management of patients and 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 information aid could be able to guarantee to all the staff a coordinated and integrated activity in different parts of the system.

A network-based information system was set up five years ago interconnecting the different units and health

care services of the clinical departments of the CNR Institute of Clinical Physiology in Pisa, to achieve a transparent access to patient data, both administrative and clinical, reaching a total integration among different human and instrumental sources [1,2]. The final electronic medical record is a multimedia collection of data automatically selected from different remote databases, e.g. echo lab, cath lab, chemical lab, nurse system, administration, etc.

Electrocardiogram is the most common diagnostic tool in a cardiological department and it is the most frequently performed test. Therefore, since the beginning of the information system implementation, it was planned to integrate ECG devices, as possible including signals. Conversely, ECG-system was the last one to be installed for the difficulties met in the integration of ECG devices in the network.

Today the operation of most ECG devices is still based on proprietary software, communication protocol and file format. Even if communication and format data problems are solved, i.e. by implementing the SCP-ECG standard, the ECG device requires a further software customization to import admitted patients work-list and to avoid unnecessary data entry [3]. Only the collaboration with the manufacturer can overcome this major problem.

Object of this paper is the description of problems we had to cope in the integration and use of ECG-system in the ward of our Institute.

2. Methods

Digital ECG devices from only one manufacturer were chosen, according to manufacturer's agreement in supporting device integration.

The SCP-ECG standard allows a reliable communication between ECG devices and hospital information system [4]. Signal acquisition and patient data are quickly transferred and saved: as soon as the patient is admitted to the hospital, his name is sent to the ECG device to update the internal list of patients. The instrument keyboard and screen allow the operator to select the patient or, to enter a new patient name in case of emergency (Fig 1).



Figure 1. ECG device: the keyboard and screen allow patient name selection or, to insert a new patient name.

Each ECG device has to be continuously connected to the network to allow a time-based update of the internal list of patients. The device can be temporarily disconnected from the network for bed-side recording or emergency (Fig.2); in this case attention has to be paid by the operator in writing correctly the patient name which is the only data, together with admission date, able to identify not yet registered patients in the central database.

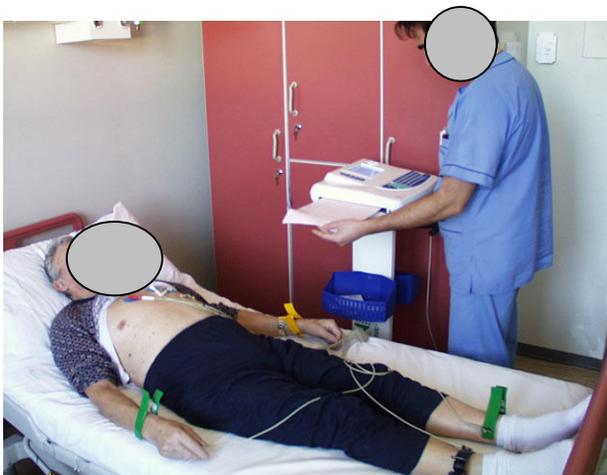


Figure 2. Bed-side ECG registration.

Moreover, the network connection of the device allows nurses to send easily the ECG recordings from the local device to the central database to archive and to update patient clinical record. As soon as the ECG data are transferred to the database they are contemporarily available for consultation to all the authorized users of the clinical department. ECG report is in charge of selected

medical personnel who can input diagnostic conclusion at all the system workstations available in the department; physician signature is saved together with ECG examination data (Fig.3).

The specifications of the system were defined according to nurses requirements and the implementation suffered of many upgrades following the user complaints and suggestions, and trying to optimize the nurse activity, taking care of the overall system ergonomics

ECG data are stored in the central database of the HIS and they gain all the privacy and security facilities of the overall system. ECG examinations, including signals, can be viewed everywhere by authorized persons through a common Web browser inside the intranet environment of the department.

3. Results

The ECG-system was daily used in these last 12 months; 12 doctors and 28 nurses were in charge of the experimental test of the system. An average of 4 ECG recordings per patient were collected during each hospitalization. Conventional paper was still produced from the device to allow traditional ECG consultation and to archive ECG strips and reports as required national legislature.



Figure 3. ECG trace viewed from Medical Record.

During this 12 month period, among the 5 ECG devices available in the clinical department two of them (ELAN Cardioline) were devoted to the experimental test; nurses were trained to the proper use of the devices and they were strongly advised to employ them in daily activity; physicians were educated to the new ECG procedure and invited to gain of the direct consultation of

could gain by the full and instantaneous integration in the patient Medical Record. The availability of native wireless ECG device could dramatically improve the power of an ECG system, lightening the operator actions and guaranteeing an immediate availability of data for archiving and distributed visual consultation.

The efficacy of such a system is based on the effective and fruitful co-operation between any partner during its implementation. A diffuse utilization of different commercial ECG devices might consent to compare the automatic reports and ameliorate their performance, with beneficial effects for both customers and industries.

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Address for correspondence

Carpeggiani Clara
CNR Institute of Clinical Physiology
V Moruzzi, 1 56124 Pisa- Italy
E-mail address: clara@ifc.cnr.it