

# Interaction and Dialogue Between the Users and the Patient Record Core of Hospital Information System: looking for a solution

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## ABSTRACT

*The lack of good user interface, in terms of both modality of dialogue and system behaviour is the major impediment to the acceptance and routine use of the computer based patient record (CPR) core of a hospital information system.*

*We describe here the adopted approach to face the daily users' needs, overcoming the pitfalls of the paper based patient record (PPR), and giving the physicians an exhaustive modality for CPR inspection.*

## INTRODUCTION

In 1988 M. Collen [1] stated that the goal of a hospital information system should be to " use computers and communications equipment to collect, store, process, retrieve, and communicate relative patient care and administrative information for all activities and functions within the hospital [...].Such an integrated, multifacility, medical information system should have the capability for communication and integration of all patient's service life time, from all the information subsystems [...] and to provide [...] clinical decision support". Hammond [2] underlines the importance of this statement, since it recognizes that clinical information is not the property of a single facility, but rather is part of a global resource which focuses on the patient-centered record.

Although integrated patient-centered information systems have great potential, acceptance in medical practice is slow, especially for systems that are designed for use by physicians themselves.

Mc Donald [3] states that it is the provision of information and support to the medical professional that is so important in making patient record systems acceptable and effective, and that the direct use of systems by medical professionals must remain the goal. The lack of good user interfaces, in terms of both modality of dialogue and system behaviour, is the major impediment to the

acceptance and routine use of the health care professional workstation.

The needs of patient's data inspection by health care professionals are numerous, in relation to different situations in which they occur: in the following we describe the adopted approach to face the daily users' needs in order to achieve acceptance and routine use, and hence effectiveness, of the integrated patient-centered information system that we are constructing.

## BACKGROUND

More than 60% of the patients coming to our centre collect a long series of encounters, alternating hospitalizations, ambulatory examinations, lab and diagnostic tests. In such a situation of shared care, completeness and timeliness of information are necessary and important from the point of view of both patient care and the expenditure control [4,5]. Time-oriented fashion is the proper data review modality .

Moreover our institution has the dual function of patient care and clinical research: all the physicians are both clinicians and researchers. They need data collection and pool mechanisms integrated throughout the patient care process .

The well-recognized shortcomings of the paper record [6] are, hence, particularly evident in the daily life of our centre. In pursuing usability and acceptance for all the professional roles involved in health care delivery and research , we have developed , and we are still working at, a system [7] that addresses many of the issues relating to each user.

At present the system covers, in addition to the administrative services, the internal medicine unit, the nephrology unit, the dialysis service, radiology, and two laboratories. In a few months it will also include the oncology unit.

## DATA MODEL

The common denominator of information is the patient, uniquely identified inside the hospital information system, and detailed through structured information within each unit.

Similar to [8], our CPR has two basic components:

- Event: it is the information "byte" of the macro-structure. Examples are a physical exam, a diagnosis, a lab test.

- Encounter: it pools a set of events. An example is a hospitalization, whose associated events are at least: history of present illness, past medical history, general health status, physical exam, diagnosis, prescription, but can include any detailed formal representation of findings, collected for both clinical and research purpose of each unit.

Some events can be seen as both a keyword inside an encounter, and stand alone or be pooled with others of the same type. A typical example is the "history updates".

At present, links between encounters and events (other than those predefined for that encounter) are provided for lab tests.

Structured information has well-known advantages and disadvantages. The definition of events embodied in an encounter entails a semi-structured modality of recording notes that can be considered a first step towards a more formal representation of findings.

## INTERFACE / DIALOGUE

The starting point of our design was to maintain, as much as possible, the same scenario for both input and retrieval of data, since:

- the direct use of the system has to be pursued and favoured.
- during the input phase, the necessity of moving along the time scale, remaining in the same context, is frequent.

Usually dialogue means an on-line interaction between a user and the procedure. For an inpatient clinic, where bed side terminals are not available, on-line dialogue is restricted to the scope of the study of a case before and / or after a round visit, or in terms of progression. We would enlarge the meaning of dialogue to the added value a procedure can provide also off-line, as typically for example an inpatient pocket rounds report.

Moreover, differences in the kind of interaction required by physicians are due to the characteristics of the patient. If the patient is subjected to a standardized protocol of therapy, or to a substitutive treatment, or is in follow-up, monitoring of previously well-defined variables is mandatory.

### Operative choice for graphical interface

As regards the interface, we adopted the standard GUI already known by most of the users through the various commercially available packages in Windows environment. The reasons were:

- to provide the same look and feel to all the procedure used for both care delivery and personal productivity
- to reduce the apprehensions due to a new system .

Multiple document interface provides the management of congruent sheets: in our case, congruency consists in the fact that each sheet (text, structured form, graphic) regards the same unique patient.

### Physicians' interaction

Physicians principally interact with the patient record core of the hospital information system. The clinicians' activities are scarcely observable, especially as regards the way of searching for information, and fieldwork is seldom exhaustive.

The questions are: what is the purpose for an inspection of the patient record, and then what is the information the physician needs?

To gain insight into the tasks that a CPR should support, a thorough analysis of the uses of paper medical record in relation to various clinical situation ought to be done. Tailoring Nygren [9] observations to our clinical environment, the main tasks the CPR has to support are:

- a - To obtain an overview of an unknown patient
- b - To search for specific facts
- c - To test hypotheses in a problem solving context

To face these situations, we provide the following five tools

- History
- Encounter- oriented patient record
- Info-patient
- Lab test specialized visualization
- Filter

whose combined use allows both a broader and deeper inspection of information.

Two of them are also support for clinical research.

### History

The initial history and each subsequent update are events. A collection of all the occurrences of such an event, merged with diagnosis and therapy, represents a first minimum tool to obtain an overview and understanding of a patient. Since reading long texts on screen is not comfortable, a printed output is available. The benefit this tool provides is the pooling of information from the many different encounters that a patient can collect during time and in different places inside the centre.

### Encounter-oriented patient record

To have a closer look at the records, whether a patient is hospitalized or being seen in an outpatient clinic, the encounter-oriented patient record is provided.

Fig. 1 shows an original event screen inside a hospitalization, particularly the event of history. The screen is composed of:

- A background on which all the events typical for this encounter are iconized together with a tool for the visualization of tests.
- A current sheet. For the history the sheet is divided into two parts: the upper one contains the previously collected and consolidated history, while the lower one is devoted to the eventual input of an update (we made the choice of unifying input and retrieval screen).

Zoom button and scroll bar permit the browsing of information.

Clicking icons, the current sheet is modified to inspect other events.

On the lower right corner, a drop down list box operates the time scale navigation through encounters of the same type, with contextual changing of the contents for the iconized events.

Depending on the patient's situation (follow-up, subjected to a protocol, etc), specific views of particular data sets are the tools physicians need to evaluate the progression of the patient. Parallel to this standard fashion of input and retrieval, outputs tailored to specific problems are provided.

### Info-Patient

The third modality of interaction, able to be activated from any previously described screen, is called Info-Patient.

Each event and encounter can be chronologically listed as an index to scroll (chronological info-

patient). The selection of an item causes the opening of a window containing the related information. If the item corresponds to an encounter, a text composed of the summation of the generally available embodied events is provided. Coming back to the index, the pointer remains at the last selected item to avoid disorientation.

While in the chronological info-patient events are presented singly (thoracic X-ray, abdominal ultrasound, etc), in the sectorial info-patient (fig. 2) events can be grouped in up to three levels: radiology/ultrasound/abdominal ultrasound or lab test/renal profile. Each level is accompanied by the date of last occurrence. Once an item has been selected, the physician can choose the dates of interest and have a time-oriented report of the information organized as a cross-tab (similar to fig.3) or as a scrollable text (similar to fig. 1) depending on the content of the event.

### Lab test specialized visualization

Fig. 3 illustrates a specialized tool for lab test visualization.

It provides a complete view of all the results of lab tests to which a patient has been subjected in a period. The two drop down list boxes, located at the top of the screen, allow the physician to restrict the selection to particular lab test events, identified at the moment of order entry for a specific clinical or research purpose.

Two picture buttons (upper left margin) can be used when visualization refers to a pre-identified group of patients, instead of a single patient. In this case, filtering of the events is essential to make the observation homogeneous.

### Filter

Together with a tool (parameter filter) to select population, on the basis of structured information tailored to the needs of each unit, a composite filter (value filter) is provided to inspect lab test results (fig. 4). It offers the possibility of extraction of lab test results of interest, in the presence of matching conditions, during a period, for one patient or a group of patients.

## **RESULTS**

Our main purposes were: 1) to overcome the shortcomings of the PPR [6]; 2) to give the physician (clinician and researcher) an exhaustive and flexible modality of CPR inspection.

Operazioni sui dati Procedure Finestra 2

Gestione Reparto 5 / Ambulatorio - Utente: CARAMIA

Anamnesi patologica di LIDIA

Ricerca  
Data 28.03.1995 Firmato: Dott. Giuseppe BRUNETTI  
Precedente  
Reparto 5 - DIAGNOSI NEOPLASIA DEL COLON OPERATA  
Successivo  
Data 28.03.1995 Firmato: Dott. Giuseppe BRUNETTI  
Reparto 5 - TERAPIA Laeviac 1 cucchi al mattino  
Magnesia 1 cucchi alla sera

Raccordo anamnesi patologica

Stampa  
Esol

PAZIENTE NOTA PER PRECEDENTI RICOVERI RELATIVI A NEOPLASIA DEL COLON ASCENDENTE OPERATA. ESEGUE CHEMIOTERAPIA CON 5 FU + LEDERFOLIN

Finestra 2

Stampa  
Esol

Visualizzazione esami del

Scorretti Data corrente 3 21.04.1995

FIG. 1 ENCOUNTER-ORIENTED PATIENT RECORD

Operazioni sui dati Procedure Finestra 2

Gestione Reparto 5 / Ambulatorio - Utente: Dott. Vitantonio CARAMIA

Visualizzazione esami del paziente

Ricerca  
Specifica  
Condizione

Precedente  
Successivo

Figura  
Stampa  
Esol

Transaminasi - G.P.T.	12	24.02.1995	25.02.1995	23.03.1995	24.03.1995	21.04.1995	22.04.1995
Proteina totale	8						
Albumina nel siero	56.9						58.6
Globuline alfa 1 siero	2.9						2.8
Globuline alfa 2 siero	7.7						6.6
Globuline beta 1 siero	5						5
Globuline beta 2 siero	4.4						4.2
Globuline gamma siero	23.1						22.8
Rapp album globul siero	1.32						1.41
Sideremia	105						66
Transferrina	234						269
Urine - Aspetto							
Urine - Colore							

Menu Principale Ricerca Paziente Esame obiettivo Sintesi Diagnosi

Scorretti Data corrente 6 26.06.1995

FIG. 3 LAB TEST SPECIALIZED VISUALIZATION

Operazioni sui dati Procedure Finestra 2

Gestione Reparto 5 / Ambulatorio - Utente: Dott. Vitantonio CARAMIA

Esami del paziente

Unità	Ultima data	Sottunità	Ultima data
Ricovero reparto 5	09.05.95		
Altro	29.04.95	Profilo ematologico	10.05.95
		Altro	22.04.95

Richiesta periodo

Data	24.02.1995
	25.02.1995
	23.03.1995
	21.04.1995
	26.05.1995
	26.06.1995

Scorretti Data corrente 6 26.06.1995

FIG. 2 SECTORIAL INFO-PATIENT

Filtro esami - nuovo

Criteri d'estrazione

Esame	Valore	U.m.
Ematocrito	> 30	%
Ematocrito	< 20	%
Ferritina	> 200	ng/ml
Ferritina	< 200	ng/ml

Esami da visualizzare

Ematocrito  
Ferritina  
Eritrociti nel sangue  
Volume globulare medio  
Emoglobina  
Sideremia

Data inizio  
Data fine

Carica filtro Salva filtro

OK Annulla Elimina Reset

Lista esami

Unità Esami clinico clinici  
Ricerca sider.

ScFD  
SHBG  
Sideremia  
Siero WWV - Brucella  
Siero WWV - S. p. TyphA - tot  
Siero WWV - S. p. TyphB - tot  
Siero WWV - S. Typhi (ant. O)  
Siero WWV - S. Typhi (ant. H)  
Sistema HLA B27  
SM  
Sodio nel siero  
Sodio urinario  
Sodio urinario 24h  
SSA  
SSB  
T Quick - Attività protrom.  
T Quick - INR.  
T3  
T4  
TAG 72  
Tempore articolare  
Tempore da ferita  
Tempore faringeo  
Tempore uretrale

FIG. 4 VALUE FILTER

Info-patient tool , accessible from each site where a patient is to be treated, overcomes the limited availability and legibility of the PPR

In relation to the purposes of CPR reading, mentioned in the previous paragraph, we can consider a) and b) points satisfied by history tool, encounter-oriented patient record, info-patient and lab test specialized visualization tool. As regards the problem solving context, the value filter tool used for a single patient may be considered an additional support that accompains the other ones.

From the point of view of the clinical researcher, lab test specialized visualization and filter tools can provide insights. We think that, even though trials and epidemiological studies can be successfully carried on through the introduction of ad hoc structured events, retrospective analysis must be performed with circumspection.

### CONCLUSION

Excluding lab personnel, 28 physicians, 47 nurses and 4 secretaries have the system at their disposal. As regards the internal medicine unit, the nephrology unit and the dialysis service, all the physicians and nurses use the system as a tool for daily activities. After an initial three week training , each unit has turned the patient's information management from manual to computerized. The fact that the system is actually in use for all the patients means that the system has been, at least, accepted.

On the contrary, physicians of the radiology service (7 people) don't use it as a tool to get information. A reason is their need of images, more than data, and the system, up to now, does not manage images.

We are testing the perceived usefulness and ease of use of the system by questionnaires, to evaluate effectiveness and efficiency of the tools we have developed. We believe that the more archives increase, the more users can realize the added value obtainable from the system, and also give insights to improve it.

Although we have made significant gains in providing information to users, we still have much to accomplish, especially as regards human-computer interface. We have to point out that on-line interaction with the CPR is mostly performed by the physicians during the phase of input of the events of an encounter. The use of larger screens (19 inch) should allow the user to have different tools at his disposal at the same time. Navigation

would be easier, making relationships between information more evident, and hence helping physicians in their decision making process.

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