

Potential Benefits and Functionalities of a Clinical Information System for Orthopaedic Department

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Abstract: - The traditional paper-based patient record can no longer keep pace with today's changing needs in the medical environment; non-availability, poor structure, missing or illegible documents, and a high degree of redundancy are just some of the problems encountered. Medical archives are reaching the limits of their capacity due to the long storage times and enormous volume of the records involved. To solve these problems and, ultimately, to improve the quality of patient care, the electronic patient record has been developed, which has numerous advantages over the conventional record: It is a paperless form of documentation, it can transfer exact service data to Patient Data Management, and it saves the nursing staff time. The patient record is and will remain to be the main tool for coordinating medical actions. The new clinical information system is both flexible and efficient and has taken into account the varied demands of the clinical partners from the Department of Orthopaedic in order to guarantee user acceptance.

Key-Words: - Clinical Information System, Orthopaedic Department, Medical Reports, Medical Images

1 Introduction

Discussions on the computer-based patient record often criticize the poor state of current paper-based medical records. Information is difficult to recover from these disordered documents full of illegible notes – not only for the healthcare providers themselves but also for researchers, administrators, insurance companies, and other third parties who could benefit from having more direct access to patient data [1]. For an optimized and coordinated healthcare a complete documentation is requested.

The new departmental information system has been used at the Orthopaedic Department of the University of Thessaly in Larissa (Greece) and may help the medical personnel to collect and manage the patients data and reach decisions effectively and accurately.

2 Materials & Methods

The information system of the Orthopaedic Clinic of Thessaly University Hospital is an advanced model of a distributed information system, developed under

the aegis of the TEMETEN European programme and especially the EHR subprogramme.

The system was initially installed as a Web application, on October 2000. The trial (Beta) edition of the system, was a WIN 32 platform application, which was installed six months later, whereas the more sophisticated commercial edition installed to the Nephrologic Clinic of the "Ygeia". This improved edition is about to be installed in Larissa, within the next few months. Similar applications, also concerning the trial (beta) edition, exist at the University of Ioannina.

The whole system is compatible to the medical standard HL-7, for storing, managing and exchanging patient data through the INTERNET, between hospitals and countries.

The medical record information system is consisted of the CPR server, Authentication server, MEDPACKS repository, CPR repository and the CPR client.

CPR Server: The CPR server is a double Pentium III in 500 MHz, bearing 2 discs in Raid-0 constellation. The operating system is Windows 2000 Server and the main database is the DB2, by IBM. In the same machine runs the CPR server in charge of the exclusive communication to the database and of sending and receiving data from the client CPR software, which all the workstations of the clinic use. The basic functions of the CPR server are the following: initialization of the database, database integrity checking, integrity checking of medical data imaging (medical images – MedPacks), users access controlling system (Authentication Server), limited access rights into database subroutines, sending and receiving data between workstations and server, sending and receiving of medical images between workstations and server, update of the actions registration record.

CPR Client: In each workstation linked with the patient record filing system, exists the client version of the Clinic's information system, aiming at presenting medical data to the clinical personnel, under specific rights for the use and operation of the system, derived by the group in which the user belongs. The basic functions of the system could be briefly described as following: sending and receiving personal data, concerning the user of the application, update of the actions registration record, search for a patient record using any field available, presentation of a medical patient record, data introduction and modification, introduction and modification of medical data images, printing.

3 Results

The integrated information system, already installed in the Orthopaedic Department of the Thessaly University Hospital in Larissa (computer patient record) is consisted of a main server located in the Clinic's Secretariat and twelve terminals distributed as followed: one in the Secretariat, one in the Professor's office, one in the Consultant's office, one at the library of the department, two in the office of the interns, one in the Head Nurse's office, one in the emergency room, two in the Operating Department, one in the Out-patient Appointment room and finally one in the experimental operating theatre, where many experimental research protocols are in process. All these computers form a network, making direct data search possible at any time, from any point of the hospital. In order to be more precise, the linkage of an ultra-sound and a radiosopic device to the computer network has been achieved (through DICOM: Digital Image Communication), for the direct storage and filmless exchange of medical images. The computer network with the server are described in Figure 1.

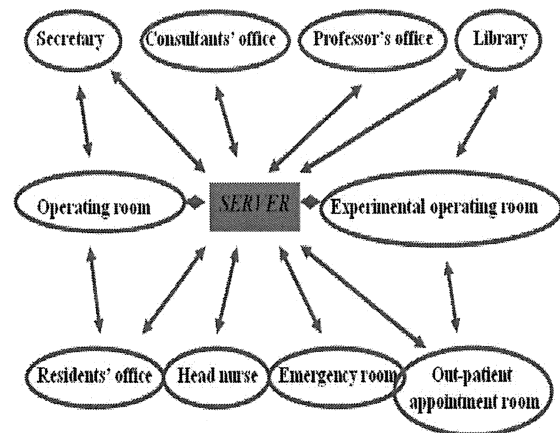


Figure 1

Access Safety: For accessing and operating this particular system, the registration of a specific access code and user name determined by the manufacturer or the licensed system user, is required. There are different access levels, depending on the user; full access for the medical and nursing personnel and controlled/partial for the clinical staff and medical students.

Patient Registration: During the admission procedure of a new patient, or the re-admission of a former patient, the registration of the demographic data or the medical history takes place either in the Out-patient Appointment room, in which the physical examination and follow-up of the patients are performed, or in the Emergency room. In the

case of a long-term follow-up or a first physical examination, cardboard sheets are filled by the doctors in charge, which are registered electronically later, by a special associate of the Department who has undertaken this particular role.

Data Retrieval & Management of Records: Search and direct data retrieval of any former patient of the Clinic is now possible. We can now monitor the course of every patient from the moment of the initial diagnosis and admission, until the treatment and final outcome of his case, through the management of his medical history, day-care sheets – temperature diagrams (figure 2), laboratory findings and operation log. The overall data evaluation and their thorough and detailed analysis help extracting important statistic data and conclusions, which facilitate clinical and experimental research. Appearance of complications, effectiveness of a given treatment plan and the overall outcome of a disease are registered in detail, thus helping the immediate and timely search of information.

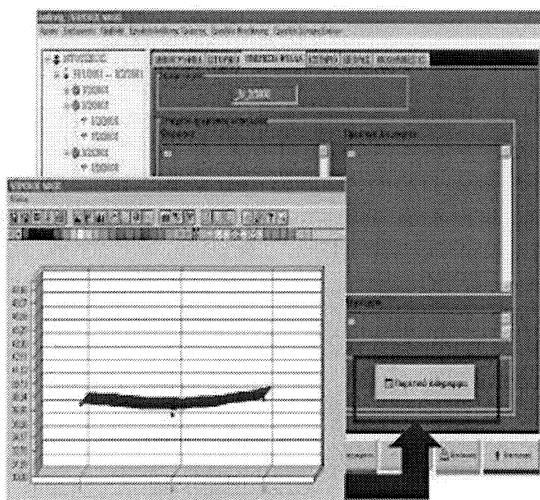


Figure 2

Storage, Management & Digital Elaboration of Medical Images: The introduction and storage of medical images from various imaging methods, such as X-Rays, U/S, CT, MRI (Figure 3) and bone scintiscan are easily accomplished into the CPR. Especially through the DICOM system we can without film store radioscopic and ultrasonic images. The system also provides the potential of digital image elaboration, partial or total magnification, as well as new data introduction essential for its detailed interpretation (Figure 4).

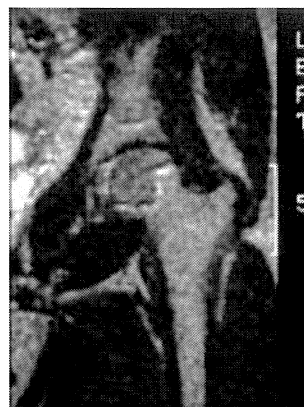


Figure 3

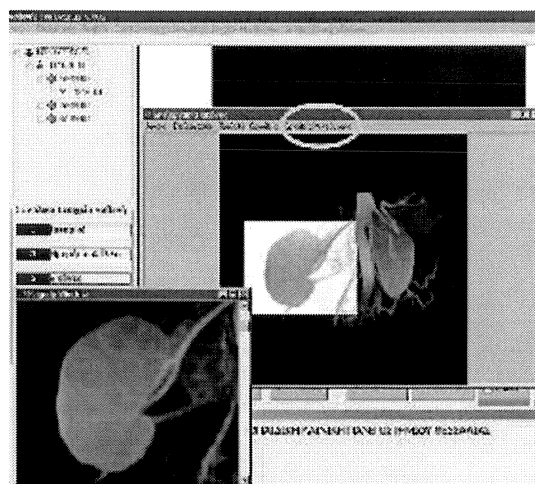


Figure 4

Management of Laboratory Results: The introduction and storage of biochemical, hematological and immunology findings, significantly help the study of the course of a disease, the effectiveness of a treatment, the timely diagnosis of complications and the final decision, even for out-patient treatment. Their direct and timely query with the use of computers, relieves doctors of large medical records, which are not easy to move and a flood of attached documents.

Operation Records: Each operation record is immediately registered either in the terminal of the main operating theatre, or the one in the doctor's office within the Operating Department, with full details concerning diagnosis, team of surgeons, type and duration of the operation, demographic data, type of anesthesia and anesthesiologist in charge, along with other crucial parameters of the operation. This registration is facilitated by an e-sheets manufacturing system known as filemaker 6.0,

which runs separately from the EPR. The network users can collect data from both programs, in order to serve specific purposes. This particular program offers a variety of choices and management, depending on the parameter been set, with corresponding results (for instance total knee replacement number, or surgeon's name). This procedure facilitates the conduction of mainly retrospective studies.

Completion and Printing of Discharge Papers and medical reports: The corresponding discharge papers, including in-patient course and direct post-operational instructions, accompany the patient's discharge, along with a formal medical report, which can be used in any public and private service.

4 Discussion

The installation and use of the WIN 32 information system, by the Orthopaedic Department of Thessaly University Hospital, had unquestionable advantages.

First of all, as expected, the volume of paper been used decreased. However, apart from the quantitative decrease (reflecting also to the cost) there was also a qualitative improvement to the flow of papers in the Orthopaedic Department, due to the easier access to standardized electronic forms for insurance purposes, medical reports for public services and easier paying-off obligation procedures. The easier compensation of patients from their Fund, due to the accuracy of the data provided to them, consisted in a material facilitation for the latter.

The registration of patients also became easier, having as a result the obvious advantage of direct access to their medical history, with the potential of simultaneous access by different users, when needed, along with their easier therapeutic and post-operative management and necessary re-admissions.

Another related advantage is the validity of data from the registration teams, due to the standardized communication language that is used by the information system, which minimizes terminology error margins.

There has also been a serious improvement of the in-patient management, through direct monitoring of the changes in the patient's situation, by the terminals and almost real time notification for the outcome and findings of an operation, from any of the 12 terminals available (which is obviously beneficial for the interns and medical students and gives intervening capacity to the Professor). Indeed, every medical incident is a snapshot at the back of the head of an experienced doctor. Younger colleagues do participate, however, to the intergraded management of the patient's health care,

so a way should be found to transmit that knowledge, to the benefit of their scientific education and of the patient's welfare. The information system of the Orthopaedic Department is moving towards this direction.

Following a steady pace, the Orthopaedic Department of the University of Thessaly is beginning to have a satisfying place in the international Orthopaedic community, by sending data to international fora and exerting the potentials, that modern Telematics has to offer. The publication of scientific papers has also become easier and retrospective research, based on the Clinic's material, can be conducted with the necessary speed, validity and timeliness.

Finally, the administrative advantages also appear to be great, since the ease at managing information leads to crucial and timely interventions, on behalf of the Professor.

The impending interconnection of the Radiology Department and the Biopathology Laboratory to the system is expected to improve the X-Ray, radiosopic, CT and MRI projections, due to direct filmless data exchange, to accelerate laboratory finding updates of the Clinic and to have a time gain of approximately 2 hours/patient as an average, which could be disposed for their more efficient care.

Naturally, the application of the information system in the Department's environment demanded some premises, on behalf of the users.

Thus, satisfying computer operation capacity is almost taken for granted; however, that kind of knowledge is considered a necessity for any updated scientist nowadays.

There can be difficulties at the initial use of the information system and the swift and direct registration of data is made possible after the necessary familiarization. Although the learning curve of the System is rather steep, the assimilative capacity on behalf of the personnel, depends highly on their skills, along with their preexisting experience.

5 Conclusion

Departmental information systems can bring significant assistance to the hospital staff regarding data collection and handling. Providing the medical and care personnel with new tools to guide the care process and to manage the diverse databases upon which care decisions are based can be very beneficial [3]. A new departmental information system such as the CIS for the Orthopaedic Department may help to improve healthcare and

save resources while supporting reimbursement by improved documentation. When nurses and physicians are able to make better decisions in less time, both patients and the institution are well served. A careful analysis of departmental structure is the fundamental base for successful customizing. The system should reflect the workflow and may lead to optimisation but respect and mirror common and special medical tasks.

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References:

- [1] M. Berg, *Medical Work and the Computer Based Patient Record: A Sociological Perspective*, Methods of Information in Medicine, International Journal of Science and Technology, 1998, pp. 294-301.
- [2] J. Dudeck J, *New Technologies in Hospital Information Systems*, IOS Press, Netherlands, ISBN 9-051-99363-3, 1997.
- [3] M. Ball, *Healthcare Information Management Systems*, Springer Verlag, New York, ISBN 0-387-97434-2, 1991.
- [4] A. Daskalaki, et al, *Use of an Intranet-based Electronic Patient Record System in Laser Medicine*, Proc. of the 5th World Congress of the Internet in Medicine MEDNET 2000, Brussels, 2000, pp.226-227.
- [5] R. Dick, E. Steen, *The Computer-Based Patient Record: An Essential Technology for Health Care*, D. C.: National Academy Press, 1991.
- [6] N. Karanikolas and C. Skourlas, *Interconnection of Laboratory Information System and Hospital Information System. The case of ARETEION University Hospital*, WSEAS Transactions on Systems, Volume 2, Issue 4, 2003.
- [7] R. Altman, *Informatics in the care of patients: Ten notable challenges*, Western Journal of Medicine, 166(6), pp. 118-122, 1997.
- [8] E. Shortliffe, *Doctors, patients and computers: Will information technology dehumanize health care delivery?*, Proceedings of the American Philosophical Society, 137(3), pp.390-398, 1993.
- [9] P. Degoulet, et al, *Introduction to Clinical Informatics*, Springer-Verlag, New York, 1997.
- [10] F. Puckett, *Medication management component of a point-of-care information system*, Am Hosp Pharm 1995, 52, pp.1305-1309.
- [11] A. R. Bakker, C. T. Ehlers, J. R. Bryant, W. E. Hammond, eds. *Hospital Information Systems: Scope-Design-Architecture*, Amsterdam: North Holland Publ Comp, 1992.
- [12] M. J. Ball, M. F. Collen, eds. *Aspects of the Computer-based Patient Record*, Springer-Verlag, 1992.
- [13] H. Prokosch, J. Dudeck, *Hospital Information Systems: Design & Development Characteristics* Amsterdam: Elsevier, 1995.
- [14] N. Saranummi, *Healthcare Inform. Framework - Information systems with Fading Boundaries*, Int J of Biomed Comput. 1995, pp. 99-104.
- [15] J. R. Scherrer, C. Louis, F. Borst, *Diogene 2, a distributed hospital information system with an emphasis on its medical information content*, In: Van Bommel JH, McCray AT, eds. 1995 IMIA Yearbook of Medical Informatics. Stuttgart: Schattauer Verlag, 1995, pp. 86-97.
- [16] J. J. Cimino, S. A. Socratous, P. D. Clayton, *Internet as a clinical information system: Application development using the World Wide Web*, Journal Amer Med Inform Ass 1995 (2), pp. 273-84.