

## Scientific papers

### **The Epidemiological and Territorial Health Information can Support Strategic Decision**

R. Benardon

*Via Monfalcone 42, Busto Arsizio, Italy*

*Introduction:* Why do we speak of Territorial Health Information system? Because the progress made in terms of technology and in the field of communication system is changing the situation radically. This situation has led to a new definition of some fundamental concepts concerning health. Designing activities for a “Territorial Health Information System” A territorial Health Care System is being designed as a reference model based on the monitoring of the balances among the social, clinical, nursing, economic and strategic activities. The goal of the project is to outline, debate and verify (continuously) the trends of the model, in order to improve the whole knowledge that supports the strategic decisional process.

*Materials and methods:* Virtual Health Organizational System (VHOS): The main objective of this kind of project is the coordination (virtual and real) of the VHOS. It is possible to build up the role of the VHOS toward the territory, feeling and obtaining strong and stimulating concepts, as for example: the chance to transform different VHOSs in an open and dynamic system of systems interacting among the VHOSs themselves and between the VHOSs and their territory toward a continuous improvement and a continuous improvement of the improvement. This mechanism must be based on the excellences/inefficiencies analysis; that means to pursue the company’s goal of a META-VHOS inter-VHOS / interdisciplinary, finalized to a constant improvement of the results in terms of E-E&Q based on the correct involvement of the interested Organizational Objects and the whole information and organizational systems. Organizational Objects: The system is built on a new methodological approach: Object oriented, finalized to the organizational flexibility and user friendly management; it particularly consists of a design of the clinical process and all the organizational and productive objects linked to the process. That means, from the productive point of view, to consider and collect all the simple components, that, along the process, are repetitive with a statistical meaning as regards the specific pathology (or other elements, that characterize all of the components) and to “encapsulate” them in a unit, that we will define “Object”. We often meet repetition of this whole and we will use this as a unique object. Because in this case they are productive components, the object will be called “productive object”. Under the organizational profile, design “organizational objects” means to find all the human resources, identify the different duties (functions), times etc. and to build-up, dynamically, the optimal team for the specific care goal.

*Results:* Flexible Strategic Health Management (FSHM): A FSHM is a computer supported system, in which during predefined health processes all the resources (organizational and productive objects) are modeled; so it is possible to simulate the health processes either from the strategic point of view and from the managerial ones, for example in order to evaluate the exact resources needed for a specific activity; with this goal we are identifying all the activities and the sub-processes in a specific database and in order to manage this data-base we are designing an expert system that will support the process-planning staff in planning the processes. In order to keep the evolution of the health status under control, we are developing a management information system; sure we will take a long time, in which

the physician will record manually all the planning activities. This is necessary in order to create an affordable process history before converting the system from passive to active in supporting the physicians in their planning activities. All these manual activities will be recorded in both data & knowledge systems and when the clinical staff, responsables of the project, are sure that the history is affordable, the expert system will be activated as planning support system.

*Discussion:* Management Information System by Object–Process–Activity: The information system must guarantee both the management of the objects and the decisional support to the decision makers inside the object itself; for this second objective we outline the importance of a planning and control model, based on the KKI, able to support: (1) the control, (2) the inefficiency analyses, (3) the identification of the excellences (top quality), (4) the trends analyses and the benchmarking projects, (5) the market's and the territory's feed-backs control, (6) the revenue control, (7) the costs analyses.

*Keywords:* Strategic health management, Information system, Organizational model, Decision support systems.

### **IRIS: An Internet Based 3D Radiotherapy Planning and Information System**

A. Lüttgau, M.A. Keller-Reichenbecher, W. Schlegel, R. Bendl

*Introduction:* Due to the large number of different parameters, which have to be considered, the method of three-dimensional radiotherapy planning is a complex and time-consuming process. Since three-dimensional treatment planning allows a precise conformation of the dose distribution to irregular shaped target volumes, it has more and more displaced the two-dimensional method. Due to the complexity of the 3D planning process it is difficult for the physician to create a treatment plan as fast and good as possible. To simplify and to expedite the process of treatment planning we are developing an Internet based integrated information and planning system for radiotherapy, called IRIS.

*Materials and methods:* IRIS consists of several applications implemented in Java on client side respectively in C/C++ and Java on server side. The communication between client and server is based on a CORBA network. The communication between the different server processes is based on PVM, CORBA and Java RMI. TAPIR, one component of IRIS, is a knowledge-based system, developed for the automatic generation of preoptimized radiotherapy plans. TAPIR is connected to the server by CORBA. The server part of IRIS is a collection of several parallel processes running on different computers. The client part is running either in an Internet browser or as a downloadable independent Java application.

*Results:* IRIS is designed as a system consisting of four integrated components: (1) tutorial of 3D radiotherapy planning, (2) atlas of dose distribution, (3) teletherapyplanning, (4) discussion forum. The prototype of the atlas is now ready for a first clinical test. In the course of this test the knowledge base of TAPIR will be filled with clinical plans. Appropriate to a given tumour localization and treatment technique, TAPIR creates several sample plans which can be examined by the dose atlas application. The server part of IRIS has been tested on Linux and DecUnix and the client part on Internet Explorer 5 and Netscape 4.7. The other three components of the system are still under development.

*Discussion:* The Internet and its technologies are ideal methods to distribute clinical knowledge as well as research knowledge. The atlas can facilitate the planning process. The tutorial shows the possibilities of the different treatment techniques. The discussion forum and the teleplanning component will allow the discussion of difficult cases with other therapists in order to improve the quality of the plans. Therapeutic knowledge and sample plans can be collected through the discussion

forum. The collected plans can be added as precedent to the knowledge base by a knowledge engineer. This will lead to a dose atlas always showing the state of the art of radiotherapy planning.

*Keywords:* Radiology Information System, Integrated Advanced Information Management System, Telemedicine, Knowledge-Based System.

### **Internet of Dublin Core Metadata in CISMef, a Structured Health Resource Guide on the Internet**

B. Thirion, S.J. Darmoni, J.P. Leroy, M. Douyère, J. Piot

*Medical Library, Rouen University Hospital, 1, rue de Germont, 76031 Rouen, France*

*Introduction:* The objective of CISMef is to describe and index the main French-speaking health resources to assist health professionals during the search of electronic information and knowledge available on the Internet. CISMef is a project initiated by the Rouen University Hospital (RUH). Its Universal Resource Locator (URL) is <http://www.chu-rouen.fr/cismef>. CISMef began in February 1995 with the creation of the RUH's Web site. In May 2000, the number of indexed resources totalled over 9,000 with a mean of 51 new sites each week. CISMef uses two standard tools for organizing information: the MeSH (Medical Subject Heading) thesaurus from the US National Library of Medicine and the Dublin Core metadata format.

*Materials and methods:* Description of the Dublin Core The Dublin Core (DC) is a metadata element set intended to facilitate discovery of electronic resources, <http://putl.org/dc>. Originally conceived for author-generated description of Web resources, the DC is now used by museums, libraries, government agencies, and commercial organizations. The building of an interdisciplinary, international consensus around a core element set is the central feature of the DC, which benefits from active participation and promotion in some 20 countries in North America, Europe, Australia, and Asia. The DC is intended to be used by non-catalogers as well as resource description specialists.

*Results:* The fifteen Dublin Core elements are optional. Resources included in CISMef are described by the 11 following items of the 15 taken from DC: author or creator, date, description, format, identifier, language, publisher, resource type, rights, subject and keywords, and title. CISMef does not use the other DC fields (contributor, coverage, relation, source). The following eight fields are added in the metadata and are specific to CISMef: institution, city, province or state, country, target, type of access, cost and sponsorship. >From 1995 to 1999, CISMef used only static HTML. As CISMef uses the MeSH to index resources, every HTML page is based on a MeSH term. In May 2000, CISMef used 2,100 MeSH terms (11% of the MeSH thesaurus). Table 1 gives the Dublin Core elements used in the metadata of each CISMef MeSH Page (paralysis as an example). These elements are manually written and updated by the CISMef team. Since 2000, CISMef has also used automatic HTML to generate one HTML page for every indexed resource. Table 2 gives the Dublin Core and the CISMef elements used in each CISMef resource page. These elements are automatically written from the CISMef database. *Example of a description of a document indexed in CISMef:* Protocol for the Investigation of Acute Flaccid Paralysis and Suspected Paralytic Poliomyelitis, [http://www.hc-sc.gc.ca/hpb/lcdc/bid/di/polio\\_e.html](http://www.hc-sc.gc.ca/hpb/lcdc/bid/di/polio_e.html). Working Group on Polio Eradication and the Division of Immunization, Bureau of Infectious Diseases, Laboratory Centre for Disease Control, Health Canada, Ottawa, Canada. *Keywords:* paralysis, poliomyelitis resource type: practical guideline, technical report. Table 1: Dublin Core metadata elements used in a CISMef Mesh Page – These DC are common to all MeSH pages in CISMef. Table 2: Dublin Core metadata elements used in a CISMef resource page.

*Discussion:* The Internet facilitates the communication between health professionals and with the general public, and also improves information access. However, only a minority of medical resources available on the Internet have a valid information content. Several tools in the retrieval of health information on the Internet have level 1: search engine, general or more; been distinguished and structured: level 2: catalogue and index; specialized searches, such as MedHunt-Ch; level 3; without thesaurus, such as and Medical Matrix-Us and MedWebPlus-Us; catalogue and index with thesaurus, such as the UMLS (Unified Medical Language System) metathesaurus and MeSH thesaurus. The latter thesaurus is used in the following Health catalogues: DDRT-Se, CliniWeb, Oregon Health Sciences University-Us, OMNI (Organizing Medical Networked Information-Uk) and HON level 4: catalogue and index with thesaurus, metadata (Health on the Net-Ch); and description of sites. To our knowledge, CISMef and Healthinsite-Au have now reached level 4. OMNI indexes approximately 4,500 resources, mostly from UK, CISMef about 9,000, mostly from France, MedHunt and HON approximately around 40,000. OMNI and MedWebPlus use the UMLS metathesaurus to provide a conceptual network to the subject headings. OMNI, HON, and CliniWeb have also developed a structured database (dynamic HTML), which permits better searches. Healthinsite and CISMef use the Dublin Core metadata format, which is expected to become the dominant metadata format for Internet resource description. CISMef use DC differently according to “browse” (CISMef MeSH Page, table 1) or “search” (CISMef resource page, table 2) strategy chosen by the end-user. The choice of the Dublin Core was prompted by its institutional origin and its notoriety in the academic world. Several other health sites are now using the Dublin Core: Australian Department of Health and Aged Care, Better Health Channel, National Health and Medical Research Council, and WHO (World Health Organization). The use of metadata is one main criterion to assess the quality of health information on the Internet. The use of metadata implies the necessity to structure information. The quality of metadata description reflects the quality of online information. The DC provides an economical alternative to more elaborate description models such as the full MARC cataloging of the library world. Finally, promoting a commonly understood set of descriptors that helps to unify other data content standards increases the possibility of semantic interoperability across disciplines. The diversity of metadata needs on the Web requires an infrastructure that supports the coexistence of complementary, independently maintained metadata packages. Conclusion: To help healthcare professionals and health consumers to more easily locate high-quality health information on the Internet, catalogues must use standard tools especially metadata to describe and index resources. Acknowledgement: CISMef was supported in part by the grant No. 1998 06 016 from the Agence Universitaire de la Francophonie in the program “French-speaking Virtual University”. The authors thank Richard Medeiros for his advice in the editing of this manuscript and Myriam Quéré for her secretarial assistance.

*Keywords:* Abstracting and indexing, Cataloging, France, Information Storage and Retrieval, Internet; MEDLINE.

### **Development of a High Level Security Policy (HLSP) for the Processing of Medical Data and their Transmission Through the Internet**

C. Ilioudis, G. Pangalos

*Faculty of Technology, General Department, Informatics Laboratory, Thessaloniki, Greece*

*Introduction:* The Internet provides many advantages when used for interaction and data sharing among health care providers, patients and researchers. However, the advantages provided by the Internet come with a significantly greater element of risk to the confidentiality, integrity and

availability of information. It is therefore essential that an appropriate High Level Security Policy (HLSP) for the processing of medical data and their transmission through the Internet must be developed and implemented by the Health Care Establishments. A HLSP is a set of high-level statements intended to provide guidance to those members of the Health Care Establishment personnel who are involved in the processing and management of sensitive healthcare information. This paper defines such a HLSP, which establishes the basic security requirements that must be addressed in order to use the Internet to safely transmit patient and other sensitive Health Care information. This development has taken place in the framework of the Intranet Health Clinic project.

*Materials and methods:* The proposed HLSP has been developed by a top-down approach and it has been based on a detailed study of the existing framework in the EU countries, USA and Canada and on consulting with users in the framework of the Intranet Health Clinic project. More specifically this paper has taken into account the major directives, technical reports, law and recommendations, which are related to the protection of individuals with regard to the processing of personal data, and the protection of privacy and medical data on the Internet.

*Results:* The end result is the definition of a High Level Security Policy for Health Care Establishments, which includes a set of seven principles and forty-four guidelines and establishes the basic security requirements that must be addressed in order to use the Internet to safely transmit sensitive Health Care Information. The proposed principles and guidelines have been made as generic and open to specific implementations as possible to provide maximum flexibility and adoptability to local environments.

*Discussion:* The High Level Security Policy should be fully adopted from all members of Health Care Establishment in order to be effective. It is clear however that they could only serve as reference material for developing an appropriate HLSP in a specific implementation environment. When implemented in specific environments, these principles and guidelines must also be complemented by the appropriate measures, which are installation dependent. It is also worth noticing that even when a High Level Security Policy already exists, it is advisable to the management of the Health Care Establishment to periodically revisit it, to see whether it should be modified or augmented.

*Keywords:* Computer Security, High Level Security Policies, Internet Security, Security of Health Care Information.

## **Evaluation of the Patient Internet Cafe at Rouen University Hospital**

M. Douyère, K. Böer, I. Sanchez, S.J. Darmoni

*Computing Department, Rouen University Hospital, 1, rue de Germont, 76031 Rouen, France*

*Introduction:* For 6 years, the Rouen University Hospital (RUH) information system has been connected to the Internet. The main goal of the advanced technologies use at RUH is to disseminate the right information and knowledge to the right end-user: CISMef, therefore, we developed several projects following this objective: Virtual Catalogue and Index of French-Speaking health resources since 1995 Library, which includes Medline and 90 full text electronic journals in English and French since 1997. Every department library is connected to the Internet French Medical Virtual University, consortium of 7 medical schools (Grenoble, Lille, Marseille, Nancy, Paris, Rennes, Rouen). In January 2000, a Patient Internet Cafe (PIC) at RUH was implemented to permit a free and "infomediated" Internet access at the main cafeteria of the RUH to patients, their families and friends. This paper is intended to evaluate the PIC use during a five-month period.

*Materials and methods:* Since October 1999, the RUH has been participating in a yearlong European project EVS-PIC (European Voluntary Service -Patient Internet Cafe). This project is part of

the “Multilateral and Third Countries project” of the DG XXII of the European Commission. The original idea for the PIC project came from the members of the European Office of the World Health Organisation (WHO), and notably from the network of “Health Promoting Hospitals”. The objective is the Prien am Chiemsee setting up and evaluation of a PIC in 9 European hospitals: Rouen, France; Bruck an der Mur and Vienna, Austria; and Koblez, Germany; Ustrom, Poland; Milan, Italy; Letterkenny and Dublin, Ireland. The idea is to develop a hospital Internet Cafe, which is open to patients, their families and to the general public (the Netizens). The PIC at RUH was opened in January 2000. It is situated in the reception area of the main building, near the main cafeteria, thus a strategic position where the patients and their families can freely have access to the Internet. Kathrin Böer and Inès Sanchez, two young volunteers of EVS, have been responsible for getting it up and running. Stefan Darmoni, Advanced Technologies Manager, and Pascal Garel, Assistant Director in charge of International Relations are supervising the project. The CISMef team, and in particular Magaly Douyère, were in charge of training the volunteer supervisors in the necessary Internet skills. A questionnaire containing 12 questions was designed to evaluate the project and the level of interest it has generated. It has been systematically filled in by the users of the PIC.

*Results:* 147 visitors filled the questionnaire during the period of January to June 2000 representing 101 working days (average of 1.45 per working day). The overall number of visits during this period is 385 (average of 3.81 per working day). The visitors were: patients (35%, n=51), relatives of patients (24%, n=35), friends of patients (18%, n=27), and others (hospital employees) (23%, n=34). The age of the visitors was: under 15 years in 1% (n=1), between 15 and 19 years in 11% (n=16), between 20 and 24 years in 22% (n=32), between 25 and 29 years in 22% (n=32), between 30 and 34 years in 10% (n=15), between 35 and 39 years in 14% (n=21), between 40 and 44 years in 8% (n=12), between 45 and 49 years in 3% (n=5), between 50 and 54 years in 5% (n=7), between 55 and 59 years in 1% (n=1), 60 years and more in 3% (n=5) of the cases. The percentage of the female visitors was 34% (n=50). Most of the visitors had already used the Internet (68%, n=100). Among them, 43 visitors had access to the Internet at home, 30 at work, and 17 elsewhere. Internet was used once a day by 48 visitors, once a week by 24, once a month by 13, and less than once a month by 6 visitors. These visitors found their first use of the Internet difficult in 12 cases, average in 58 cases, easy in 21 cases and very easy in 9 cases. The main uses of the Internet at the PIC were for searching for general information (40%, n=58); sending and receiving E-mails (20%, n=30); searching for medical information (18%, n=27); using other tools (14%, n=20); Usenet, Listserv, or Chat rooms (5%, n=8); and search engines (3%, n=4). The visitors needed the help of the volunteers in 70% of the cases (n=102). This help was considered very helpful in 90 cases (88%), helpful in 10 cases (10%), and average in 2 cases (2%). None of them found this help to be bad or very bad. A large majority of visitors (86%, n=127) said they would return to the PIC, 4% didn't know (n=6) and 10% said they wouldn't (n=14).

*Discussion:* The PIC at RUH is not a quantitative success as only 0.4% of the 1,000 daily visitors and patients passing through the Cafeteria area showed interest. When implementing this PIC a higher rate was expected – between 3 and 5%. The marketing strategies were evidently not strong enough. After a regional TV interview about the official opening of the PIC, the number of the daily visits tripled within two weeks. Overall the PIC at RUH is a qualitative success, as a lot of PIC visitors returned to it during their stay or visits to RUH because the average number of individuals per working day is 1.45 and the average number of visits is 3.85. Another positive aspect of the project is that at RUH, the main objectives of the PIC have been fulfilled: – promotion of the Internet tools, especially Email and the Web, for the RUH patients, their families and friends; – improvement of patient education by giving access to quality documents, which are indexed in the CISMef database and available on the Internet, the PIC is already a part of the virtual library available at RUH; –

contribution to patients' quality of life during their hospitalization. This was notably achieved by creating electronic links between patients and the outside world. Two results of the questionnaire were astonishing: (1) This PIC situated in a University Hospital was not frequently used for searching health information (only in 18%). When implementing this PIC, it was expected that a vast majority of searches would be about health. It seems that the visitors were more inclined to use the Internet Café as a means of distraction from their daily routine and not necessarily for research purposes. (2) Approximately a quarter of the visitors were hospital employees who were too shy or not allowed to use the Internet in department libraries. Some results were expected as similar to polls: two thirds of the visitors were male, aged between 20 and 40. The qualitative PIC success is mainly due to the two volunteers: 70% of the visitors needed their help. Among these visitors, nearly 90% considered the volunteers help as very important. In conclusion, the main proof of the PIC success is the fact that at RUH the service will also be available next year.

*Keywords:* France, Health Education, Hospital Information System, Patient Education.

### **Using Digital Certificates for Access Control in Clinical Intranet Applications**

I. Mavridis, C. Georgiadis, G. Pangalos, M. Khair

*Informatics Laboratory, Computers Division, Faculty of Technology, 54006 Thessaloniki, Greece*

*Introduction:* Access control in medical information systems distributed over the Internet is an important issue directly related to the protection of patients' privacy. Clinical electronic records usually contain data that are shared between source systems in a variety of locations that are involved in a healthcare intranet application. Internet technologies were designed to optimize information sharing not security. Recent efforts to preserve a satisfactory level of Internet security rely on public-key cryptography. A Public-Key Infrastructure (PKI) supports the issuance and management of digital certificates suitable for identification and authentication purposes. In addition, the emerging complementary Privilege Management Infrastructure (PMI) can provide another type of certificates that are particularly suitable for authorization purposes.

*Materials and methods:* In order to fully exploit digital certificates to protect clinical intranet applications there is however a need of a suitable security policy, compatible with the PKI and PMI environments. Such a security policy is our already known DIMEDAC (Distributed Medical Database Access Control) security policy, which has the required structure and also has been proved to be able particularly suitable in healthcare environments. In this way digital certificates can provide sufficient access control in clinical intranet applications. In DIMEDAC security policy, which is based on both mandatory and discretionary security models, a differentiated role-based authorization mechanism is provided for accessing the medical records, depending on the particular values of the identity-based context parameters of users that form the user location. The access control mechanisms consist of user-role, data-set and user-location hierarchies and a set of authorization rules. When a user initiates a new session, he must first identify and authenticate himself by using his identity certificate. Then he activates a subset of user roles and locations, which form a session-dependent user profile that is recorded in a set of short-lived attribute certificates. In subsequent user access requests, an access decision-making process takes place, which uses the combination of identity and attribute certificates of the user.

*Results:* The described certificate-based access management provides sufficient access control in clinical intranet applications. It offers strong authentication making all parties to feel confidence and secure. It is also suitable for fine-grained access control, it guarantees user privacy and confidentiality

and it is capable to provide user accountability. Attribute certificates also provide a means for exchanging in a secure way user profiles between different healthcare institutions.

*Discussion:* The use of electronic certificates in access management is the best way to provide sufficient access control in medical intranet based applications. This can be achieved by the proposed use of the PKI and PMI infrastructures together with our DIMEDAC security policy.

*Keywords:* Computer security, Medical database security, Distributed access control, Digital certificates.

### **Reading Factor as a Credible Alternative to Impact Factor: a Preliminary Study**

S.J. Darmoni, F. Roussel, J. Benichou, G.C. Faure, B. Thirion, N. Pinhas

*Introduction:* The impact factor (IF) published in the Science Citation Index Journal Citation Reports by the Institute for Scientific Information quantifies the influence of a periodical on secondary publications and is very commonly used not only to rank and evaluate journals but also for academic promotion or for the selection of research grant applications. However, the users of bibliometrics claim that IF is marred by numerous limitations. Indeed, the scale of IF varies widely between scientific fields and medical specialties and a given IF is not, per se, a good indicator of scientific value. There is no correlation between the citation frequency of a given paper and the impact factor of the journal in which it has been published. Citations themselves should be carefully analyzed, and citation bias has been widely discussed recently.

*Materials and methods:* Electronic access to full text journals has been available in university and hospital settings for a few years. Specific software can be used to measure the numbers and types of articles consulted. Based on the use of such software, we propose to develop a new means of evaluation of the usage of journals by end-users, and of their impact on medical practice and research processes. Because such an analysis directly relies upon the consultation of articles, we suggest to define a new index called "reading factor" (RF). RF can be calculated as the ratio between the number of electronic consultations of a given journal divided by the mean number of journal consultations (itself calculated by dividing the total number of electronic accesses by the number of journals in the database).

*Results:* The RF distribution was assessed for the year 1999 when 45 medical journals from Ovid (Biomedical collections I, II and III) were available to the medical community of Rouen University Hospital. 8280 publications were accessed during that year. The mean 1998 IF of these journals was  $5.9+6.4$  (mean+SD), the median value was 3.5 (range 1.4–28.8). The mean number of articles electronically consulted was  $184.0+177.8$  and the median was 125.0 (range 9–901). While the mean was 1 by construction, the observed RF median was 0.69 (range 0.05–5.01). Pearson's correlation coefficient between IF and RF was positive ( $r=0.29$ ) and borderline significant ( $p=0.052$ ). However, as the distributions of IF and RF were clearly not normal, additional analyses were conducted. First, the New England Journal of Medicine was the most influential journal in this analysis and strongly induced a positive correlation between IF and RF because of its very high IF (28.7) and RF values (4.1). Indeed, the correlation coefficient calculated for 44 journals (excluding this journal) was no longer significant ( $r=0.046$ ,  $p=0.77$ ). Second, no significant correlation could be found either using log transformed variables ( $r=0.048$ ,  $p=0.75$ ) or the Spearman rank correlation coefficient ( $r=0.083$ ,  $p=0.59$ ) on all 45 journals.

*Discussion:* These results suggest that RF provides different bibliometric information than IF. The frequency of use of a journal could therefore be a significant parameter of its interest to the readers and could be used as a more relevant marker of a given journal's influence. Electronic access allows a



reliable and automatic analysis of the consultation rate, with a minimal delay, while conversely, IF is delayed by 2 to 4 years according to its calculation method and provides a less accurate reflect of current trends in science. Such an analysis provides an appreciation of the readers' interests in real time. The absence of correlation reported here between IF and electronic consultation of journals warrants further studies and should stimulate research on new ways to evaluate the scientific and medical interest of publications. These observations also suggest that the use of the impact factor as a universal means of evaluation of papers, researchers and research units is grossly overrated. The rapid increase of paper and electronic journal price has made essential the optimization of collection management. Our results suggest that collection managers would not be able to predict electronic journal use on the basis of journal impact factors. In complement to quality criteria, we propose RF as the economic criterion to optimize electronic journal management in academic institutions, as the cost of a click can easily be compared to the cost of a photocopy obtained from other institutions. As our approach to assessment of electronic journal use is simple and automated, aggregation in real time of all available individual results from institutions or from commercial providers is a foreseeable possibility. The emergence of a wide scale centralizing center, on the model of ISI for IF, would be required to accomplish this task. A typology of readerships and a typology of journals could be achieved by correlative examination of RF and IF. Biomedical publications could be classified in those of scientific interest ( $IF > RF$ ), those of major scientific interest ( $IF \gg RF$ ), those of clinical interest ( $RF > IF$ ), or of major clinical interest ( $RF \gg IF$ ), and mixed ones ( $RF - IF$ ). Conclusion The measurement of RF is highly automated and practical. RF is an objective and immediately available criterion of local journal use.

*Keywords:* Bibliometrics, Internet, medical libraries/ec, periodicals, publishing.

### **Internet Patient Records: new Techniques**

S. Moehrs, G. Brelstaff, P. Anedda, G. Zanetti, M. Tuveri

*CRS4 – Center for Advanced Studies, Research and Development in Sardinia, CRS4 – BioMedical Area, VI Strada Ovest, Z.I., Macchiareddu, 09010 Uta (Cagliari), Italy*

*Introduction:* Our experimental Electronic Medical Record (EMR) system, based on second generation Internet technology, securely transmits hierarchically organized patient records to the clinician's web browser. In the browser we deploy Java applets, JavaScript and HTML to provide different interactive views of the patient record and its subsections. The result is a set of generic reporting tools that allow the medic to annotate, view and interact with the patient data. Here we present an enhanced version of the system shown at PAJava2000, whereby medics can prototype their own reporting tools simply by writing HTML, allowing an appropriate customization. As before XML remains the transport protocol for hierarchical data.

*Materials and methods:* Second generation, non-proprietary, Internet technology continues to furnish the basic infrastructure of our EMR client: It makes requests for XML patient records that are then downloaded into its Document Object Model (DOM, the emerging industry standard browser database). A summary view of that patient's data is automatically generated and presented by applying a template, contained in an XSL style sheet (eXtensible Style Language). From the resultant HTML page a suite of context-sensitive, pop-up tools – for exam viewing and clinical reporting – are available for launch. By following a componential software architecture that de-couples presentation, communication and data content we are able to reduce overall complexity of our system. One benefit of this approach is that it is possible for specialist clinicians to design and prototype their own report structure before including them in the system. >From a technical point of view, clinicians write HTML

text, which the EMR client can automatically convert into reporting tools with a graphical enhanced user interface. This conversion is achieved simply due to the transparent availability of certain JavaScript libraries.

*Results:* We proposed an experimental medical information system, which allows an effective presentation of patient data. A medic can interact with this data in an intuitive way by consulting the corresponding reporting tools. Besides the reporting tools, the following components are implemented in our EMR system towards this end: – An EMR Browser for displaying patient records. – An Image Viewer that allows clinicians to interact with image sequences. – An xy-Graph to visualize features of imaging exams. – An SVG Viewer (scalable vector graphics) as image map for the report lets.

*Discussion:* Our experimental system is currently being adapted for use in a hospital in Sardinia. As such it will constitute a test-bed system in which medics will participate as both designers that provide clinical reporting tools according to their particular medical specialties and users that provide feedback. Initial work will be on supporting communication between radiologists and neurologists.

*Keywords:* Electronic Medical Record, Internet, Java, XML.

### **Evidence-based On-call**

C. Ball, R. Phillips

*Centre for Evidence-based Medicine, University of Oxford Level 3, Cairns Library John Radcliffe Hospital, Oxford OX3 9DU, Oxford, UK*

*Introduction:* Clinicians require rapid access to valid clinically-relevant high-quality advice at the bedside to help clinical decision-making. Currently this is extremely difficult, since information is frequently out-of-date, wrong or impractical for clinical care. The Centres for Evidence-based Medicine in Oxford and Toronto have been developing and evaluating a practical and accessible high-quality evidence-based resource, called ‘Evidence-based On-call’ (EBOC) electronic methods for delivering this information to clinicians at the bedside

*Materials and methods:* Evidence-Based On Call (EBOC) is a new manual that provides up-to-date, valid clinical information on common acute medical topics. For each topic, the medical literature is systematically searched and critically appraised using methodological criteria. All chapters are peer-reviewed by physicians trained in clinical epidemiology and by experts in the field. Topics are continuously updated and revised.

*Results:* Over 3000 critically-appraised topics have been completed, and have been used to create 40 clinical guidelines. A book and a website have been developed and are currently being evaluated.

*Discussion:* Previous work by the Centre for Evidence-based Medicine has demonstrated providing high-quality evidence at the bedside has important effects on clinical decision making. Evidence-based On-call is the first comprehensive manual providing practical evidence-based clinical advice that can be used at the bedside. The effects on patient outcomes are currently under study.

*Keywords:* point-of-care systems, evidence-based medicine.

### **Patient E-Care: Present and Future Applications**

A. Robert, M.D. Pretlow

*eHealth International, 5406-K Lake Washington Blvd. N.E., Kirkland, WA 98033, USA*

*Introduction:* Online patient care or patient “e-care” could revolutionize the centuries-old medical practice paradigm. Patient e-care can bring back the “house call” experience long-missed by consumers and could potentially allow healthcare to become proactive rather than reactive. Moreover,

patient monitoring and interactive management data can be fed directly into patient electronic medical records. This presentation will explain what patient e-care is, how it is currently used to manage common chronic conditions, and what will be possible with the intriguing new technologies on the horizon. What do consumers want versus what do providers want, and how do you meld the two together? Analogies to online investing and e-commerce will be discussed.

*Materials and methods:* Examples of patient e-care via interactive disease-specific web sites will be demonstrated. An exciting new development in patient e-care, patient home monitoring via the web, or “e-monitoring”, will be described. Several e-monitoring instruments will be demonstrated. A pilot project involving six healthcare providers was conducted to monitor six selected patients, at home, affected with enuresis, hypertension, obesity, congestive heart failure, diabetes, and asthma. Patients used home monitoring instruments, connected to the Internet. The instruments automatically sent patient data via the Internet to a web site. The patients’ providers were able to view their patients’ results on the web site and send secure messages to their patients.

*Results:* All 6 patients participating in the pilot study felt positive about interaction with their providers online and monitoring of their medical conditions without having to travel to their provider’s office. Moreover, the patients felt more secure in that “someone was watching over them”. Most providers felt that they did not have enough time in their busy schedules to learn the new technology required, review daily patient data, or interact with their patients online. Providers expressed a want for solutions that offer better patient care but would also not require more time from the providers.

*Discussion:* Consumers/patients embrace the concept of e-care. Providers, however, tend to be threatened by a change of the medical practice paradigm and by the (perceived) impingement upon providers’ hectic time schedules. Technical e-care solutions must address both patient wants and provider concerns. Solutions that save time for providers, while still offering the advantages of patient e-care, must be found. For example, Internet software that automatically monitors and even manages some aspects of a patient’s condition, while keeping the provider informed, appears to be one solution.

*Keywords:* online care, patient e-care, e-monitoring, Internet patient care.

### **Interactive Medical Web Sites for Children and Teenagers**

A. Robert, M.D. Pretlow

*eHealth International, 5406-K Lake Washington Blvd. N.E., Kirkland, WA 98033, USA*

*Introduction:* Interactive health websites for children and teenagers involve unique challenges. In particular, chronic conditions such as bedwetting, obesity, asthma, diabetes, and attention deficit disorder are associated with significant social isolation. Children with these conditions feel different/weird and alone. Experience with two global medical websites for children and teens with chronic conditions will be presented.

*Materials and methods:* Web sites were created for children with nocturnal enuresis (bedwetting) at <http://www.wetbusters.com> and for children with obesity at <http://www.blubberbusters.com>. Each site has areas for children of different ages. Each area contains age-specific interactive educational content, a clubhouse, interactive games, a bulletin board, chat rooms, and an interactive care area.

*Results:* Children and teens using the sites are desperate for social interactivity, especially clubs, message boards, chat rooms, and social games. They also readily interact with children from other countries. In addition, these children crave interactivity with their health care providers, although most providers feel that they cannot afford the time required for such interaction. Unanticipated problems with message board and chat room security from predators were encountered, as well as regulatory challenges. Technical solutions have been developed for the security and regulatory issues.

*Discussion:* The Internet appears to be ideal for managing chronic disorders of childhood. The communal anonymity of the web allows children to seek information about their disorders and to interact with other affected children in a way that is not possible in real life. Guarding against web predators is imperative because of the emotional vulnerability of chronically ill children. Although most providers are currently reluctant to embrace the web as a care medium, it can provide them with better tools with which to care for their patients, as well as enhance patient satisfaction.

*Keywords:* children, teenagers, chronic disorders, Internet, web, care.

### **A Web-Based Electronic Medical Record System, based upon the GEHR-Architecture**

P. Hendrickx, F. Verbeke

*IXSys NV, Boutersem, Belgium*

*Introduction:* Based upon the Good European Health Record Architecture (GEHR), we developed an entirely new concept of electronic patient records. It will be presented as a very intuitive web-application. Mostly it will be the patient, who creates the file and controls access to it. He has the MASTERKEY and the possibility to allow complete or partial access to the care-providers of his choice. This will enable the patient to collect all his clinical data in one record, and to present this data whenever needed. The care-providers on their side can exchange information between their EPR-system and the patients EPR-system by means of IMed-XML messages. It's also possible for physicians to create a web-based record for their patients. They are then controlling the MASTERKEY.

*Materials and methods:* As database-server we used SYBASE 11.9.5, the application was developed using ASP 2.0, ADO 2.5 and dynamically created Javascript on the client side. In this EPR, we are providing a Template Editor, User Controlled Access Levels and Content Linking. In function of the information he stored in his record, interesting links will be presented to the patient

*Results:* Will be presented in a demonstration.

*Discussion:* Advantages and disadvantages of putting the patient in control of its own clinical record, will be discussed.

*Keywords:* Internet, Medical Records.

### **Creating Resources for e-Learning in French Medical Universities**

F. Le Duff, A. Fresnel, G. Herengt, J.M. Brunetaud, G. Chatellier, S. Darmoni, P. Gillois, D. Pagonis, G. Soula, M. Spector, P. Le Beux

*Medical School of Rennes, Service Du Pr P. Le Beux, Medical Informatics Avenue du Pr Léon Bernard, 35043 Rennes Cedex, France*

*Introduction:* It is now recognized that Internet appears to be a useful tool for medical training. The number of users connected on the net on one hand, and the emergence of a political support in France on the other hand, make it possible to create on line teaching system available by the net. Three kinds of public can be addressed by such a system. Firstly, the students could find relevant support systems and content for training and permanently have a set of self-training methods available associated with a variety of evaluation systems. Secondly, the teachers could offer original contents by using new technologies to explain what they want to teach. Thirdly, the administrators could manage the whole education process, by choosing the method of teaching the most adapted to the aim in view and by evaluating the effectiveness of this remote training according to the services offered.

*Materials and methods:* Beside these technical aspects, a radical change of teaching methods has to be anticipated and the contributions of the cognitive psychology are fundamentals. The new French consortium of Medical Schools wishes to integrate all these aspects in a Virtual Medical University. The method used is based on: – conceiving tools to index the resources using MESH and UMLS; – conceptual modeling to seek contents in a contextual way (what one could call intelligent search engines adapted to the medical language); – Developing various teaching approaches using the contents of the clinical and factual data bases; – And finally to take into account the scientific results of Evidence Based Medicine in the diagnostic and/or therapeutic decision-making. This method is based on data and knowledge bases tools associated with web interfaces.

*Results:* The participants of this teaching project have isolated different parts in the process. Each participant is responsible of the development of the content in which he is specialized. The Resources Servers allows to acquire, manage and store the medical multi-media resources (images, texts, documents) according to descriptive, semantic and pathological criteria's. This server will become a resource for the teachers in order to build teaching supports adapted to the various types of students or to create new teaching help using the resources of the NICT. Thus, these supports will be usable for initial or continuous teaching and particularly in remote teaching. The contents indexing should allow the optimization of the access to relevant information in the fields of medical knowledge.

*Discussion:* Creating resources for teaching medicine on the net will require specific efforts for the teachers and the faculty. Experts should organize the cultural and organizational change to meet the objectives. New education program, based on problem based learning will be required by the new French Medical curriculum. We feel that contribution of medical informatics in this area will be fundamental. Therefore we wish to reassemble our efforts and skills within a single national consortium.

*Keywords:* Virtual Campus, Internet, Medical pedagogy, Computer Assisted education, Document Indexing, Search engine.

### **Synchronized Rendering of Multimedia Radiological Information: Development of an Internet-Based Application**

R. Van de Walle, B. Rogge, I. Lemahieu

*Ghent University, Department of Electronics and Information Systems, Sint-Pietersnieuwstraat 41, B-9000 Ghent, Belgium*

*Introduction:* The success of Internet-based applications and the World Wide Web (WWW) relies to a large extent on the development of so-called markup languages, of which HTML (HyperText Markup Language) is the mostly used at the moment. HTML was initially developed for the description of textual information, and for the distribution of this type of information via computer networks such as the Internet. Nowadays, however, there is a need to develop markup languages that allow setting up network-based multimedia Internet applications. It is widely believed that the eXtensible Markup Language (XML), being a generalization of HTML, will become the standard markup language for such applications in the near future. We are currently developing a generic software framework for establishing XML- and WWW-based (World Wide Web) remote multimedia access. Possible applications of this framework are telemedicine (e.g., teleradiology) and setting up Picture Archive and Communication Systems (PACS). A variety of healthcare communication standards have been developed during the last decade. They have improved the interoperability and the connectivity in open hospital information systems to a large extent. They have also reduced time and efforts during the implementation of standard interfaces. However, the implementation of

communication standards is still far from the expected plug and play. In this context currently two major drawbacks can be identified: the lack of a standardized terminology, and the restricted flexibility of the currently used interchange formats. On the one hand the standardization of the terminology can not be solved by the standards development organizations – it is a general challenge for the medical informatics community. On the other hand the movement to a new interchange format can be initiated by standards development organizations. The application of XML/SGML (Standard Generalized Markup Language / eXtensible Markup Language) as an interchange format for communication standards offers a much greater flexibility and adaptability to user needs than the currently used interchange formats. Some concepts for a smooth change to a new direction have already been discussed in the past.

*Materials and methods:* In this presentation, we will discuss a home-built application for both describing and presenting multimedia medical/radiological data: images, the corresponding speech and text files produced by the radiologist, and administrative data concerning the study (patient name, radiologist's name, date, etc.). Users are able to access all data through a web browser by submitting a form-based request to the server. By using scripting technology, a HTML document containing all data is produced on the fly, which can be presented within the browser of the user. In order to achieve synchronized rendering of the multimedia data two methodologies have been investigated: SAMI (Synchronized Accessible Media Interchange) and SMIL (Synchronized Multimedia Integration Language). The application was implemented and tested with real data.

*Discussion:* The global architecture of the application will be discussed, as well as the most important implementation aspects. The key elements at the server side are a central database and a web server. At the client side all information is presented to the end user by using a web browser environment. In order to increase the efficiency of the application a multimedia server can be used as well. The synchronization between the different media was realized by two different XML-based technologies: SAMI and SMIL. Although SAMI was originally only developed for a limited number of possible applications, it was shown that it could be a (lightweight) tool for a broader range of applications. By nature SMIL is suitable as well, though the implementation based on SMIL was more difficult with respect to text handling.

*Keywords:* medical informatics, multimedia, database, synchronization, internet.

### **A platform-independent Datamining / Quality-Management-System with PHP3 and mySQL: A Project Study**

M. Egbring, S. Grafe, G. Hindricks, H. Kottkamp, C. Elsner

*Workgroup MedKonsult, c/o Christian Elsner Rosenheimer, Landstr. 126, 85521 Ottobrunn, Germany*

*Introduction:* Quality evaluation and ensurance will become a substantial factor for economical aspects and comparability in medicine. Still there is a lack of sufficient guidelines and systems being able to coordinate adequate quality and give all participants up to date access to comparison parameters. The idea of the platform-independent Quality-Management-System was to set up a Prototype for the evaluation of radiographs for the control accommodations of patients with Weber B Fractures and osteosynthetic supply. Information gathered from this pilot project may then be template for further quality evaluation tools in radiology.

*Materials and methods:* The World Wide Web (WWW) was chosen as infrastructure for the System. This allows very easy access via any Browser over an Intranet/Internet-PC for all participants. The System itself is based on dynamically generated PHP3-Pages which originate from a Linux-Server/MySQL-Database. High Security is achieved via an Open-SSL Connection between Server and

Browser, the prevention of local data-caching and a unique user and session key via the PHP-language. The Forms for the data input are interactively checked with javascripts for logical mistakes. For easy maintenance a system for real-time portation of the MySQL Database to Microsofts Access Database was designed and the Server was equipped with a software for easy teleservice. For the evaluation of radiographs a self-developed standardized algorithm was used to categorize Weber B Fractures into insufficient and sufficient quality. The evaluation of the accommodations (pictures) and thus the weighting of the quality criteria were validated with the judgement of an independent radiologist on the basis of Cohen's kappa coefficient. For all recorded cases the influence of the age of the patient; the side of the body; the point of recording; the sex; the period of time between the control checks and the quality of the accommodations is calculated for different significant plateaus with a Serverside Datamining-Engine set up on the Database of recorded Cases.

*Results:* With the prototype 284 radiographs were analyzed. Statistics suggest all developed criterias to be a good marker for overall quality of the radiographs. The sex "female", "age over 40 years" and "right-side" seem to be markers for radiographs with lower quality. The Datamining-Process could also show that the use of digital x-ray technic and lamellar filters could improve quality of x-rays. The Datamining was also a good marker on distinct nurses to perform an overall lower quality of images.

*Discussion:* The developed system showed good results on the practicability of using an internet-based system for quality-ensurance in radiology. The developed algorithm for radiograph series photos of the upper ankle joint showed to be a good quality marker. By calculating correlations of definite features in an anonymized patient database with centralized administered quality criterions the system seems to be good for wide-spread quality ensurance at distinct locations. Due to the Platform-Independence the System can be used easy and due to the Client-Server architecture, changes in forms and algorithms for certain radiographs can be implemented fast.

*Keywords:* Quality-ensurance, Internet, PHP3, Radiology, Weber B Fracture.

### **Comparing Paper-based vs. Internet-/Handheld-based Clinical Trial Coordination in a Study on Hernia inguinalis: How good is cost/benefit ratio?**

C.H. Elsner, M. Egbring, A. Wolf, A. Merz, H. Kottkamp, G. Hindricks  
*Heart Center Leipzig, Russenstr. 19, 04289 Leipzig, Germany*

*Introduction:* For the conduction of clinical trials vast amounts of clinical data need to be collected, proved, organized and analyzed. Many clinical trials are still conducted paper-based with high needs for study monitors and extra queries for logical mistake correction and data consistency approval. For a while now different information support systems exist to ease workflow of clinical trial coordination. Ideal systems are easy accessible, provide high security and use peripheral Palmdevices to ease bedside Data entry. For this reason Remote-Data-Entry (RDE) via the Internet on a centralized Database is used and is seen as the most promising future technology. This architecture in combination with devices e.g. like the Handspring Visor with an Internet-PC and a Handheld-Client Software is ideal for data entry from distributed locations that have little or no computer infrastructure. Many Investigators still feel hindered to introduce the new technologies yet, as far as no exact data on benefits and cost/benefit ratios exists. The aim of this work was to get data on these questions by conducting a clinical trial both ways paper- and internet-based and compare outcomes of the two arms on different aspects.

*Materials and methods:* For a retrospective Clinical Trial on the Outcome of different surgical treatments on hernia inguinalis a standardized Query designed from the Swiss Society for Surgery was

implemented at a Hospital in Switzerland (Spital Menziken, Kanton Aargau). The implementation was both paper-based and electronically. For the paper-based approach simple multiple-choice paper sheets were filled for each patient and sent via normal snail-mail. These sheets were then double-entrytyped into an access-database from where they could be further processed. For the electronic way the World Wide Web (WWW) was chosen as infrastructure for the System. This allows very easy access via an Internet-PC for all participants and the investigator. The System itself is based on Handspring Visor Devices combined with an Internet-Docking-Cradle and a Client-Software which synchronizes Handheld-Database and central Server-Database over the Internet. The local PC is a normal Windows 95 machine, the Server is a Linux-Server with a MySQL Database. All data is calculated on the Server and Results can be viewed by the Investigator realtime via dynamically generated HTML-Pages on every normal Web browser. High Security is achieved via an Open-SSL Connection between Client and Server, the prevention of local data-caching and a unique user and session key via the PHP-language. The Forms for the data input are interactively checked on the Visor device. The System can handle complex data input and also allows to record signatures on the Handhelds. For the Investigator the System can generate graphical diagrams from the raw data in real-time on every Internet-PC with a Web browser.

*Results:* Overall the electronic system showed to perform with a highly significant better time factor. While the transfer-time from Patient-Chart to Form was in both cases at an average of 5.2 days (Paper) and 4.4 days (Electronic), the time needed for the transfer was significant different: Paper-Transfer needed an average of 12.4 days and electronic Forms were synchronized at an average time of 1.7 days. The electronic version could be viewed in "real-time" after 6.1 (avg) days, while Paper-data needed 17.6 (avg) days and had to be exported from Microsofts Access to be analyzed and graphical displayed. Data consistency was significantly higher in the electronic forms. While per Paper-Form 0.176 additional queries were necessary in average, electronic forms needed only 0.023 additional queries.

*Discussion:* The major benefits of a system like the described lie in the little need of infrastructure, the central and real-time calculation of the medical data input and the easy check of input over interactive forms. The developed platform allows easy and secure exchange and processing of study data over the Internet. Benefit against Paper-based systems are for our trial significant in matters of time and data consistency. Benefit against simple PC-based systems is the possibility of a bedside-data-input, which leads to faster data-capture in our opinion and allows treating data as source data with electronic signature in sense of FDA 21 CFR Part 11 Regulations. Overall we had good experience with our system. If a Site has Internet-Access, Investments for the system are very low by average costs of 200 Euro Hardware and 100 Euro Training Costs per User. We think that a system designed like ours will reduce costs significantly in bigger trials, were costs per additional query rank at about 100 Euro.

*Keywords:* Clinical Trials, Internet, Palm Pilot, Surgery, Cost/Benefit Ratio.

### **Automatic Management of Uniform Resources Locators for Medical Training**

S. Ducamp, F. Le Duff, B. Pouliquen, A. Fresnel, A. Burgun, P. Le Beux

*Regional Hospital, Medical Informatics, 2 rue Henri le Guilloux, 35033 Rennes Cedex, France*

*Introduction:* The main objective of this work is to help the URL management for the training of students using the Virtual Medical University available at the Medical School of Rennes. With the increase of the number of connections and the number of medical documents available on this network, the management of new contents requires a lot of efforts for the webmaster. In order to



improve the management of the Uniform Resources Locators, we implemented an automatic web engine for teachers, able to manage the links for the most interesting resources for their practice.

*Materials and methods:* We built a relational database (Oracle) to store the main information about links (name, address, authors, email, keywords, abstract, medical subject, etc.) with an HTML form. The form is connected to an automatic browsing tool. Starting from the URL, the automatic web engine connects to the specified sites, browses the HTML codes and automatically extracts the main information included in these pages. All the information returned is stored in the database and the result is dynamically displayed on a HTML page with text, arrays and representative logos. Finally, the teacher validates this page if it is correct. To improve the links management, the user can allow the web search engine to browse the external URL that are included in the training page and the result appears in the dynamic page created and therefore it is stored in the database. The student will see directly what is the content of the training site and which external resources are available for this course.

*Results:* The URL database includes the URL and information about the link. These characteristics allow to sort and search according to seven criteria: The specialty of the training department The language used in the medical contents The interest level The level required for the user (student, continuing medical education) The subject (nosology) The type of the available document (books, clinical cases, guidelines) The document format (text, video, sound, pictures) The database is protected and only authorized users can modify information about documents included in the data base. This tool is particularly useful for foreign students, the automatic web engine is able to translate the text in six different languages (English, German, French, Spanish, Italian, Portuguese).

*Discussion:* Automatic management of URL appears to be very helpful for indexing medical contents. Very easy to use, students and teachers do not need specific training to use it. They just have to complete Internet forms to add contents or to query the database. The intranet access insures necessary security and the users do not need a special installation on their computer. We can notice that this method could be used in other domains than Medical Schools. The application has already been implemented for an automatic exploration of cardiology web sites for a commercial company.

*Keywords:* Medical training, Abstracting and Indexing, World Wide Web, Automatic data processing.

### **DNS/Hostmaster Architecture in the Greek Network of Healthcare and Welfare Services**

P. Lampsas, A. Vagelatos, D. Sofotassios, C. Papanikolaou

*Computer Technology Institute, Kolokotroni 3, 26221 Patras, Greece*

*Introduction:* Computer Technology Institute (CTI) is the technical consultant of the Greek Ministry of Health and Welfare in Information and Communication Technologies. CTI currently manages Ministry's IT projects within Community Support Framework 1994–2000 (jointly funded by EU and Greece). In this respect, CTI prepared a study that proposes design and implementation principles for DNS and Hostmaster services of the Greek Health and Welfare Sector. More specifically this study covers the following areas: – Name and IP addresses assignment policy for the Health and Welfare Sector. – The architecture of the DNS service and the administration issues, concerning the current state of networking infrastructure, as well as its escalation to a VPN for the Greek Health and Welfare Services.

*Materials and methods:* This study has been conducted in the context of a project regarding the implementation of data networks (structured cabling infrastructure, switched and shared Ethernet LANs) in 25 public Greek Hospitals. These LANs will have limited access to the Internet (until the

application of a common security framework) and will serve as the necessary infrastructure for the hosting of already existing integrated hospital information systems.

*Results:* Based on the following principles and goals we have concluded and proposed domain names for all units of the Greek Health and Welfare Sector: – Users should be able to use domain names in a tangible and manageable way, taking into consideration the current situation of health sector domain names, as well as the ISO 843-2 standard for the transposition of Greek to Latin characters. – The naming scheme should contain levels of hierarchy, thus alleviating the management efforts. – Naming scheme should be eligible with the current Internet hierarchy and the regulations issued by the national hostmasters and administrators. Including domain names the following guidelines have been issued to the ISP selected for the health sector network, for the implementation of the architecture of the DNS and Hostmaster Services. DNS Service The DNS architecture is realized through: – The implementation of primary and secondary (backup) DNS server for all the zones of healthcare sector. – The maintenance of secondary stealth name servers in every hospital. – The specification of primary name server to accept recursive queries. Hostmaster Service The Hostmaster service is implemented as follows: – Assignment of IP addresses according to operational and geographical criteria, taking into consideration the routing protocol to be used. – Use of different subnetworks of private IP addresses according to RFC1597. – Use of NAT/PAT feature for Internet access.

*Discussion:* Adopting and implementing the aforementioned rules results in the following benefits: – An overall framework for the implementation of client-server is introduced. – A uniform naming and addressing scheme is used in the Greek Health and Welfare IP Networks, thus simplifying network administration. – An improved overall network performance is achieved due to minimal DNS traffic. – The internal network structure is withheld from the Internet community. – The process of the future transition to a VPN is simplified, due to the proper allocation of subnetworks of private IP addresses. DNS and Hostmaster Services comprise the underpinnings for the TCP/IP-based networking. It is of vital importance, to coherently design and implement the architecture of these services, taking into consideration current trends in the implementation of VPNs, that is, using the public Internet infrastructure.

*Keywords:* Internet, Local Area Networks, Computer Communication Networks, Medical Informatics.

### **ICT in the Education of Medicine: Conclusions of the Inquiry**

H. Buysse, A. Derese, G. De Moor

*Ghent University, De Pintelaan 185, 5K3, Ghent, Belgium*

*Introduction:* Within the scope of the implementation of Information and Communication Technology (ICT) in the Faculty of Medicine at the Ghent University, an inquiry was performed. The goal was to start implementing ICT in education from a well-founded work basis. The policy will be tailored to these results.

*Materials and methods:* The inquiry was made in such a way that the input shouldn't take much time and that as much as possible information could be gathered. A pre-research was done by five professors. In total, 281 inquiries were sent to all the persons who teach at students in the Faculty of Medicine. Sixty-one percent responded. The topics that were questioned are: actual and future use of audiovisual material; CD-ROMs; Internet-Intranet; use of search-engines and Medline; knowledge of (computer) programs; courses/syllabi on the Net; implementation. The inquiry concluded with some open questions.

*Results:* The results learn that there is a great need of help. Above all there is a great need for “demonstrations” and a good manual. Besides that, there is a great need for information about what already exists in the field of important websites and CD-ROMs concerning ICT in medical education. Having a look at audiovisual material, one can see that there is a great potential for users; except for the use of the Interactive Voting System. Most of the respondents consider e-mail a good means to communicate with students. However one should ask oneself if they actually make use of this means. At last, almost all respondents feel that students should be capable of using Medline and that students should also be capable of finding (relevant) information on the Web.

*Discussion:* As we can see from the results, a lot of respondents are interested in using ICT in the education of medicine. However, one shouldn't forget that implementation of ICT in the education (of medicine) is mostly not the same as using a computer in the lessons or putting the course on the Net. Of major interest is to look for the added value of using ICT in the education of Medicine.

*Keywords:* Education, Medical, ICT, Implementation.

### **A Clinical Internet Trial Management System – Citmas**

K. Nelausen, H.H. Hansen

*University Hospital Copenhagen, Finsen Center, Clinical Research Unit, Blegdamsvej 9, 2100 Copenhagen, Denmark*

*Introduction:* Data monitoring, regulatory procedures and data management in clinical trials have become increasingly complex. Relational database technology and internet-based connectivity offer resources to improve protocol operations. At the Finsen Center, CUH we have developed a suite of database applications for protocol management and tracking of patient accrual. Data transactions and reporting occur through a graphical web browser interface using standard Internet technology.

*Materials and methods:* Security and confidentiality have been addressed through Virtual Private Networking, encryption, user authentication, address restriction, and database authority. All of the components operate from a secure web sever connected to the Internet and this Virtual Private Network server. Access to information can be adjusted by network location using Internet protocol (IP) address restriction and/or password authentication. The same tools can be independently used to regulate access to web pages and/or database resources. In particular read/write database access is restricted. Apart from the coordinating staff, patient-specific information can only be viewed at the treating hospital. Data entry and reporting functions is designed to operate using a standard web browser and Adobe Acrobat Reader. No additional user software or system maintenance is required. Since all programs are stored on the central server, this enables efficient access from local and remote sites without the need to update distributed software. Adoption of a web browser interface also contributed to rapid learning, as users became familiar with basic navigational tools and procedures.

*Results:* The following applications were developed: Protocol Management System (restricted access), CITMAS – Patient Tracking System (restricted access), Enrolment, Randomization, Data capturing, Reporting. Each application was centered on a web linked relational database, thus providing flexibility. The decision was prompted by the need to disseminate accurate and updated information rapidly to a variety of sites, including national and international cancer centers. In this early phase of implementation we have a total of 6 protocols and are planning for another 4. However we strive for using it on all protocols, at present 42. If on-line protocol management, data capturing and data monitoring shall prove efficient, it is important to minimize redundant tasks. This is accomplished by integrating data management with standard operational routines. Particularly the on-line database is adopted as the only database used for protocol management. Thus, our protocol system

depends on the existing centralized database, without the need to maintain huge numbers of separate databases.

*Discussion:* With complex and time-consuming KEY PROCESSES, the relational database technology and internet-based connectivity offer new resources that can be applied improving quality and efficiency of protocol management. Purchased vendor-derived software often implies hidden expenses related to interface development, customization, and maintenance. Currently no standardized commercial software has emerged that is suitable for protocol management. Therefore custom software development offers the best opportunity for integration with the existing resources, staff and SOP's. Moreover, support for data migration to new systems is easily preserved.

*Keywords:* Clinical Trials Internet Data Management.

### **Healthcare Scheduling in the Internet Age – New Forms of Healthcare Delivery**

H. Schellens

*UltraGenda n.v., Loveldstraat 31, B-9070 Destelbergen, Belgium*

*Introduction:* In the industrialized world, more than 6 billion healthcare-related appointments are made per year. The booking of each of these appointments involves two actors, one that requests the appointment, and another who books it. Streamlining this process could lead to substantial gains in efficiency. The impact of the Internet in bringing about these changes is discussed.

*Materials and methods:* What are the main characteristics of an appointment booking process (manual and computerized)? Central vs decentral appointment booking. Why is frustration omnipresent? Where does the process go wrong? All these aspects have been researched in medical practices and hospitals. The distributive approach: a revolution in scheduling. Hospital-wide scheduling via a web application. Online electronic referrals. New concepts of health delivery. The role of the patient.

*Results:* A new model of healthcare delivery, based on a web-driven, ASP-offered distributive model for patient scheduling.

*Discussion:* How can the Internet transform the delivery of healthcare?

*Keywords:* Scheduling, Appointment, ASP.

### **Design and Development of a Web-based System for Early Recognition and Monitoring of the Diabetic Retinopathy**

P. Ladyzynski, J.M. Wojcicki, K. Chihara

*Nara Institute of Science and Technology, Image Processing Laboratory, 8916-5 Takayama, Ikoma 630-0101, Nara, Japan*

*Introduction:* Diabetic retinopathy is one of the most serious late micro-vascular complications of diabetes. It is vision threatening chronic ocular disorder, which untreated, leads to deterioration of visual acuity and blindness. Diabetic retinopathy is now the most common cause of blindness in people of working age. Majority of visual loss cases resulting from the disease could be prevented if relevant medical and ophthalmologic care was administered at the appropriate time. However, because of high costs and limited number of expert ophthalmologists available, even the most developed countries can not afford to implement suitable screening program.

*Materials and methods:* The aim of this work was to design and develop web-based system for early recognition and monitoring of diabetic retinopathy. The developed system is intended to operate as follow: (1) a primary care physician takes a patient's retinal images with a digital fundus camera

and uploads them together with additional anamnesis results to a distant database through the internet; (2) an expert ophthalmologist downloads patient's data, annotates lesions directly on the fundus images using tools provided by the system and stores the annotations as well as his diagnosis in the database; (3) the physician retrieves diagnosis and annotations of the lesions. Two modes of operation are possible: telediagnosis – when all three mentioned above stages are conducted independently, one after another or teleconsultation – when interaction between the physician and the expert is possible. In this mode the physician can select a region of interest on the image, send its location to the expert and receive his annotation in real time.

*Results:* The whole system was implemented in the form of dynamically generated web pages with embedded Java applets. A simple specialized messaging server was developed to enable on-line teleconsultation. The system does not require any software installation, except web browser with java plug-in, either on the physician's or on the expert's side. The performance and proper operation of the system was confirmed during a set of laboratory tests and a simulated teleconsultation session between IPL NAIST (Nara, Japan) and IBBE PAS (Warsaw, Poland). There were no problems noted with handling of the system, even for operators, who were not trained beforehand. Tools provided to the ophthalmologist, aimed to speed up annotation process, were found to be effective and easy to use. Exchange of annotations in synthetic form, in place of transmitting full images back and forth, contributed to the shortening of the system's response time.

*Discussion:* During preliminary tests, the developed system proved to be intuitive and easy to use which is very important taking into account its prospective users. It seems, that after clinical tests, application of the developed teleophthalmology system ought to be beneficial to the diabetic patients. It should cut down the costs of the screening program and make the expert ophthalmologist easy accessible.

*Keywords:* Telemedicine, Remote consultation, Diabetic retinopathy, Diabetes mellitus.

### **Data driven WAP Applications for Medical Information Handling**

J. Dørup, M. Schacht Hansen

*Section for Health Informatics, Institute of Biostatistics, University of Aarhus, Vennelyst blvd. 6, DK 8000, Århus C, Denmark*

*Introduction:* The Wireless Application Protocol (WAP) describes a standard for serving documents and applications over wireless low bandwidth connections. The WAP technology implemented in newer mobile phones has build in facilities for handling much of the information processing needed in clinical work. To test a practical approach we ported a relational database of the Danish pharmaceutical catalogue to WAP using open source freeware at all steps.

*Materials and methods:* Web server. We used Apache 1.3 web software on a Linux server. The file types used for the WAP devices have a special set of MIME types that must be added to the web server. Database. Data containing the Danish pharmaceutical catalogue was imported from an ASCII file into a MySQL 3.22.32 database using a Perl script designed for easy update of the database when new versions are released. Data was distributed in 35 interrelated tables. Each pharmaceutical brand name was given its own card with links to general information about the drug, active substances, contraindications etc. Access was available through (1) Browsing therapeutically groups, (2) Searching for a brand name, and (3) Searching for an active substance. Programming. The database interface was programmed in the server-side scripting language PHP 3. Special care was taken to ensure that the correct MIME type was output from the scripts. Database queries were handled with SQL. A WAP Gateway was established to allow dial-in access independent of commercial WAP

service providers. A free, open source WAP gateway for Linux was downloaded from [www.kannel.org](http://www.kannel.org). Modem dial-in was set up and the WAP phone was configured with appropriate phone number, username and password and ip-number of the gateway.

*Results:* A data driven interactive WAP based pharmaceutical catalogue was established. Access to individual brand names was available through free text search or by browsing the therapeutic groups. The application was tested on the Nokia 7110 and Ericsson R320s cellular phones. Dial-in to an analogue modem was completed in about 30 sec. Navigation to a subclass lasted 1-3 sec providing access to the lowest levels of the hierarchy within an acceptable timeframe.

*Discussion:* We have demonstrated that WAP based access to a dynamic clinical database can be established using open source freeware. This opens perspectives for a further integration of WAP phone functions in clinical information processing: GSM telephony for bilateral communication, asynchronous unilateral communication via e-mail and SMS, built in calculator, calendar, personal organizer, phone number catalogue and Dictaphone function via answering machine technology. WAP technology allows access to Inter/Intranet based databases including pharmaceutical information, laboratory data, and principally access to Internet based Electronic Patient Records. However, if WAP phones are to become effective tools for physicians, special attention must be paid to the limitations of the devices. Input tools of WAP phones should be improved i.e. by increased use of speech control. An independent WAP gateway may be placed within hospital firewalls, which may be an advantage with respect to security.

*Keywords:* Medical Informatics Applications, Database Management Systems, Dictionaries-Pharmaceutical, WAP, Open source software.

### **INCAS: a Telemedicine Network for Multi-Diagnosis Consultation Services**

C. Colombo, A. Castelli, B. Salvatore, A. Lesma, N. Dal Degan

*CEFRIEL – Centre for Research and Training in Information Technology, via Fucini, 2, 20133 Milan, Italy*

*Introduction:* Several telemedicine applications have been developed for improving the health care in areas lacking in specialistic medical resources. A specific situation is represented by drilling sites located in Third World countries: the physician responsible for the local community has to face every kind of problem without the specialist's support. The INCAS project (Interactive Teleconsultation Network for Healthcare Services) answers to this need offering a system that allows on-line teleconsultations in a wide range of medical branches.

*Materials and methods:* The system has been developed as requested by the medical service of an Italian oil company, matching its specific needs and making use of the existing resources: images, biosignals and textual data had to be acquired, viewed and shared over dedicated satellite lines ranging from 64 to 19 kbps. We could not find in the market a single system able to accomplish all of these tasks, so we realized a platform which integrates acquiring devices (e.g. film scanners, electrocardiographs, cameras) and transmission channels using standard protocols. The physician working in remote countries, through an innovative and easy to learn user interface, can acquire clinical data, work in stand-alone making textual and graphical annotations, and discuss the case with the specialist located in Italy. The major difficulty we ran into has been to permit the on-line teleconsultation over such a small bandwidth. We overcame it by pre-fetching data to the reference hospital, allowing in this way a real co-operative work even on limited connections.

*Results:* After a validation period, the system has been installed in June 1999 in Pointe-Noire, Congo, and in July 2000 in Port Harcourt, Nigeria. Over 50 cases have been successfully discussed

since then in the following branches: radiology, dermatology, cardiology, heart surgery, infective diseases. New methodologies are being introduced, and the system is going to be installed in other sites in Africa and Asia.

*Discussion:* Thanks to its easiness of use, INCAS is being used daily and it represents a successful example of telemedicine for its effectiveness. Over-estimation errors can be avoided, thus reducing the number of unnecessary and expensive repatriations.

*Keywords:* Telemedicine, Remote Consultation, Delivery of Health Care.

### **An Infrastructure for Integrated Electronic Health Record Services: The Role of XML**

D. Katehakis, S. Sfakianakis, M. Tsiknakis, S. Orphanoudakis  
FORTH, PO Box 1385, Heraklion, GR-71110, Greece

*Introduction:* People have parts of their medical record located in all the places where clinical services have been applied to them (e.g. in community doctors, primary care, and secondary care). All these segments, which are related to personal healthcare delivery and well being, reside in disparate and in most cases not directly accessible places. Moreover, a number of restrictive policies do not allow carrying personal sensitive clinical information outside the corresponding organization boundaries, while the healthcare providers keep on maintaining detailed and confidential notes about their case. Any I-EHR environment should be capable of handling these issues and provide uniform ways for accessing authentic, physician-generated, patient record information that is physically located in different clinical information systems. Furthermore it needs be able to provide fast and authorized on-line access to longitudinal views of each individual personal health record, in order to allow for the timely delivery of health care.

*Materials and methods:* The technological approach for implementing the I-EHR environment is based on the HYGEIA Reference Architecture (HRA), which provides the necessary framework for the reuse of services, components, and interfaces. These services include at the middleware level resource, authorization, naming, messaging, terminology, semantic mapping, and other meta-data services, as well as services for the management of medical acts, patient identification, and clinical data location. The currently available execution architecture is based on CORBA interfaces (for data acquisition, patient identification, semantic mapping and messaging), X.500/LDAP (for security services, user profiles, patient clinical information, and healthcare resources), dedicated SQL/ODBC-LDAP gateways (for accessing primary information and for maintaining indexing up-to-date), and XML (to sustain the collected clinical information in a consistent way). Primary information is usually kept on commercial data base management systems, and this is expected to continue to be the case in the years to come.

*Results:* At its current implementation, the main objective of the I-EHR environment is to deliver an encounter-centered view of the patient's EHR. It utilizes the available CORBA interfaces to provide a consistent way to locate, access and transmit secure information about a patient's EHR segments. References to recorded data are obtained, and are used to retrieve actual information by means of the Object management Group's (OMG's) Clinical Observation Access Service (COAS) implementations. OMG's Terminology Query Service (TQS) is used to provide both conceptual mappings among the different clinical information systems available and the coding schemes they use for recording clinical findings. XML has been used to describe the COAS observation data in a human readable format. Been represented in XML, the clinical information can be transformed to many other formats using XSL.

*Discussion:* The I-EHR environment, as it has been developed and set up, provides a decentralized view of the patient medical record, by dynamically composing information that resides in a variety of heterogeneous clinical information systems. Due to the fact that users seek selective information, following specific paths depending on their personal preferences, it is expected that the I-EHR concept will eventually lead to a uniform applications and services environment. Since electronic records can provide much easier navigational facilities, navigational issues are expected to become even more important in the future, mainly because of the end-user requirements to have similar interfaces in terms of look and feel.

*Keywords:* XML, Healthcare Information Infrastructure, Component-Based Architecture, Integrated Advanced Information Management Systems.

### **Security Considerations on the Development of an Internet-Based Infrastructure for Telepathology: The Approach of the Italian Network of Telepathology for Research, Education and Quality Control**

V. Della Mea, V. Roberto, F. Barbarino, C.A. Beltrami

*Institute of Pathology, University of Udine, p. le S. Maria della Misericordia, 33100 Udine, Italy*

*Introduction:* At the present time, many initiatives are devoted to the exploitation of telematic resources, and particularly of the Internet, for creating telemedicine services such as remote consultation and distant medical teaching. Telepathology is one of the areas subjected to those efforts, with a range of applications mainly centered on remote consultation. However, part of them still pertain to research more than to daily practice, and thus often do not consider issues needed for an effective use of such tools: in particular, privacy, security, authentication. The present work discusses these topics, in the light of the development of a telepathology infrastructure.

*Materials and methods:* The main application of telepathology on the Internet is remote consultation. This task can be carried out in a store-and-forward (s-a-f) way, by means of either email or web-based repositories, or in real-time, through videoconferencing-like systems. However, s-a-f is more adequate to the current Internet performance, and also to international settings, where the time zone may differ. The rest of paper will discuss mainly the two s-a-f approaches. When carrying out a consultation, the two parties need to: – securely and privately transmit the case and the answer, – acknowledge the receipt of data, – have the certainty of the other's identity, – and have the certainty of the other's qualification, if not personally known. Either email and web have been used for telepathology consultation, but only recently their security and privacy features have been experimented. Email allows privacy-enhanced communications through S/MIME, using public key cryptography and digital signatures. An optional form of acknowledgement of receipt is also available. User authentication, needed for digital signatures, relies on certification authorities (CA). Web security features include the HTTPS protocol (for secure connections between client and server), form signing, and various forms of locally developed user authentication. In general, by means of forms, and server-side computing (CGI, servlets, etc.) it is possible to implement different schemes of interaction. So, from this specific point of view, what is the most suitable approach?

*Results:* Privacy-enhanced mail easily allows secure and private communication, through S/MIME; user authentication is left to external CAs, whose characteristics are already coded into some national legislation. Also web-based tools allow for private communications, by means of HTTPS. Identifying users on the Web is less easy: when it regards a closed user group, access to data may be limited with a set of user/password pairs. More interesting is the form signing technique (not yet fully exploited), supported by Netscape, which allows for digitally signing HTML forms. Acknowledgement of email



receipt is left the recipient, leaving unknown the status of the message. On the other side, visits to web sites can be logged. Ensuring interlocutor' qualification is not as easy as ensuring his/her identity. However, current CAs may certify also for the institution to which the user belong to; by exploiting this mechanism, professional medical societies may be the way for certifying the qualification of medical doctors, indirectly by means of an external CA or directly by running a CA for their associates.

*Discussion:* The comparison of the available security features of both approaches shows that they are very similar, except for the acknowledgement feature, which is in turn connected to the main difference. In fact, email regards the two peers, in principle without any other intermediary (although at least two servers are involved); web-based consultation is instead mediated by a third-party. This allows for a further level of services, including time-stamping, permanent storage, and neutral guarantees for both client and consultant. In our opinion, web-based tools are thus more suitable for the practice of telepathology, and this analysis is leading towards the implementation of a telepathology secure server inside the Italian Network of Telemedicine for Research Education and Quality Control in Anatomic Pathology, funded by the Ministry of the University.

*Keywords:* Telemedicine, telepathology, security, privacy, consultation.

### **The Use of Internet for Health Purposes in Brazil**

R.F. Bruns, J.S. Dias, E.R. Sbrissia, L.E.A.M. Martins, F.V. Rocha

*Pontificia Universidade Catolica do Parana, Rua Imaculada Conceicao, 1155 Prado Velho, Curitiba, PR CEP 80215-901, Brazil*

*Introduction:* In the near future practically the entire population will be connected to the Internet the same way that most of us have a telephone today. The development of the Internet will change all the parameters of social relationship, which exist today. It will be a world without distances, without barriers. As all other fields of action, medicine will be changed by the Internet. For this reason we shall know and study all the existing tendencies among health professionals who use the Internet as a research tool or the non-health professionals seeking medical information on the Internet. Much has been speculated about the potentially positive and negative impact of the Internet on patients, health care, and health promotion, but no case reports or statistical data are available evaluating this question further. This study tries to gather information in order to evaluate the use of the Internet for health purposes in Brazil.

*Materials and methods:* Based on the questionnaire used by the Health On The Net Foundation (<http://www.hon.ch>) to evaluate the use of Internet for health purposes we set up a questionnaire for the Brazilian Internet users. We made this questionnaire available on the website Medlinks (<http://www.medlinks.com.br>) which was developed by one of the authors of this research. The website is a directory of medical links used mainly by healthcare professionals from Brazil. The questionnaire was available from November 27th 1999 to February 27th 2000. After being gathered, the answers were stored in a text file, which was imported to the software Epi Info from the CDC to be analyzed.

*Results:* 1821 answers were received and analyzed. As expected, the majority (54%) were medical professionals, followed by dentists (11%). Patients accounted for only 1.6% of the answers. The geographic distribution showed a prevalence among more developed regions: Sao Paulo (30.9%), Rio de Janeiro (13.3%), Minas Gerais (8.8%). It was also clear that most of the participants lived in capitals (62%), which have better health care system than countryside cities. This may partly be a reflection of limited access to the WWW in less developed areas and recalls one principal problem of telemedicine:

that “world-wide areas most likely to benefit from telemedicine are those least likely to afford it, or to have the requisite communications infrastructure”. Regarding age, more than half (66.9%) of the participants were between 20 and 39 years old. Also, the predominant sex of the participants was male (70.5%). Access from Hospitals or Clinics is small (7.9%), perhaps a reflection of underdevelopment, where little money is invested in this kind of technology, which is still seen as expensive and with little applicability. Home access was used by 77.1% of the participants. The search for knowledge was the main motivation that led the participants to the Internet (86.9%). Papers published in medical journals and electronic books were the most searched (74.7%). The Brazilian user still is unacquainted with some tools like mailing lists, used by only 6.8%. The WWW by its popularity and easy use, still shadows other Internet facilities like mailing lists, e-mail, IRC, FTP, and so on. Regarding patients, the main use is to look for second opinions, as answered by 46.3% of the patients participating from the study. Only 37.7% of them discuss with his/her physician the data found on the Internet. This probably reflects a large number of unsatisfied patients with medical healthcare system. However little of what is found on the Internet is brought up on subsequent consultations. It seems to be easy to find medical information, both in English and Portuguese, on the Internet, as agreed by 83.1% of the participants. But the majority (95.6%) also agrees that there is a need for more available information.

*Discussion:* In the history of mankind there have been technological advances which have been decisive in its evolution. The Internet is becoming one of the technological advances of greatest impact in this century. The changes, which the development of the Internet gives, rise to, are going to alter the pattern of interpersonal relationships between human beings. The Internet is dividing medical professionals, creating two kinds of people: those who take advantage of the benefits which the information era offers, and those who live in ignorance of these benefits. Within a few years this difference will become as evident as which at present exists between those who know how to read and write, and those who do not. The Internet is so powerful as a working tool that it will create an obvious inequality between those who use it and those who do not. In such a competitive world as this, natural selection will do the rest. Nowadays a considerable number of people are connected and conducting researches on the Internet. It is considerably easy to find any kind of information on the WWW, using popular search engines like AltaVista or yahoo. This information available on the Internet can lead the patient to question the medical treatment proposed by his/her physician. This kind of behavior is very common nowadays. Who hasn't yet faced a patient with a headache demanding a CAT-SCAN? The low quality of the medical information available in the Internet must be controlled. In Brazil we still lack from that kind of control.

*Keywords:* Internet, Medical Informatics, Education, Telemedicine.

### **Intra/Extranet System for Clinical and Epidemiological Studies**

F. Sicurello, A. Nicolosi, M. Villa, S. Mannino

CNR-ITBA, INN C. Besta, Milan, CNR-ITBA, via F.lli Cervi 93, 20090 Segrate (Milano), Italy

*Introduction:* Aim of the project is the realization of an automatic system based on information and telecommunication technologies able to manage, through the network, a central database for epidemiological surveys and studies. The system will be developed to create a link between clinical and epidemiological databases and a web site framework.

*Materials and methods:* From a technological point of view, such a system can be implemented with an Intranet architecture, where the involved parts are: general practitioners, health districts, hospitals, National Health Institute, pharmaceutical industries, scientific societies, etc.

*Results:* The database is modeled to contain several epidemiological databases. Such registers are directed to the analysis of the diseases occurring in the population, of the factors causing them and of the efficacy of the treatments used for the care (with related cost-analysis). By means of these archives it is possible to conduct studies on specific topics, such as, for instance: – incidence and prevalence studies for diseases which can be diagnosed by general practitioners; – case-control studies to find out possible risk factors associated with a given disease; – pharmacovigilance studies to assess the effects of a drug when used on a large scale, so as to know all its characteristics (adverse reactions, interactions with other drugs, new therapeutic indications, etc.).

*Discussion:* In this way, the databases can be consulted by several health operators (in particular general practitioners) and can be upgraded in interactive way, constituting a health portal. The system, will provide services such as: – collection of data and information from general practitioners and health structures; – availability, for the users, of the results of statistical analyses carried out on data stored in the database; – tools for data inquiry and analysis (search engines, indexes, statistical software for the epidemiology).

*Keywords:* epidemiology, database, statistical analysis.

### **Visually lossless Image Compression for Teleradiology**

W. Stefanon, D. Auer, M. Grobovschek, L. Auer

ISM, Jakob-Haringer-Str. 3, 5020 Salzburg, Austria

*Introduction:* Image compression could be a stimulus for the acceptability of teleradiology due to a reduction of transmission time. The range of acceptable compression rates depending on the compression method and the imaging modality used are widely unknown. Aim of this study was therefore to define clinically acceptable rates for JPEG and Wavelet compression for different imaging modalities.

*Materials and methods:* To define thresholds of acceptable compression rates (“visually lossless”, i.e. lossy compression unrecognized by the medical expert), two different studies were performed: Study 1 on 135 cerebral MR images employing 10-12 compression levels with JPEG and Wavelets (Matlab for JPEG, MT-Wice Photo for Wavelet) resulting in 852 JPEG and 640 Wavelet-compressed images. Evaluation was done by experienced physicians by rating image quality on the randomly presented images: (1) “Acceptable image quality”, i.e. “no apparent degradation of image quality”. (2) “unacceptable”, i.e. distortions interfered with appropriate diagnostic evaluation. (3) “borderline”, i.e. minor degradation of image quality thought to not impair diagnostic accuracy. Study 2: Four series of different radiological images (24 MR-images, 8 MR-angiograms, 21 renal angiograms, 6 conventional myelograms) were used at 10 compression levels with JPEG and Wavelet algorithms, resulting in a dataset of 966 images. Two strategies were employed: (i) using the evaluation criteria as in study 1 and (ii) comparing the compressed images with their uncompressed counterparts. Investigators had to rate whether the compressed image was degraded or not. The average maximum compression rate unrecognized by the experts (“visually lossless compression”) was determined at the 98 percent confidentiality level.

*Results:* Using strategy 1 and JPEG (Wavelet) compression, all MR-images and x-ray-myelograms could be compressed up to 16:1 to 19:1 (MRI 16:1, x-ray-myelograms 83:1), renal MR-angiograms at 12:1 (85:1). Using strategy 2, renal MR-angiograms were acceptable up to 32:1 (57:1), x-ray-myelograms up to 16:1 (37:1), brain MRI up to 20:1 (20:1), and brain-MR-angiograms up to 32:1 (23:1).

*Discussion:* The present study indicates that image quality does not suffer from compression up to 16:1 with any of the investigated imaging modalities. Imaging modalities and compression methods. Low resolution images, and in particular MR-Flow studies, allowed for higher compression rates. Moreover, Wavelet compression was markedly superior for renal angiograms and x-ray-myelograms.

*Keywords:* Medical image data compression, Teleradiology.

### **The UK Telemedicine Information Service**

J.S. Briggs, A.K. Francis, K.A. Smith, R.G. Curry, B. Madge

*University of Portsmouth, 1-8 Burnaby Road, Portsmouth, PO1 3AE, UK*

*Introduction:* Telemedicine is being used increasingly as a means of delivering healthcare services. In the UK, we are aware of well over 100 projects involving telemedicine. Some of these are current, while some have concluded in the past couple of years. A few are in the process of developing into full-blown services. The UK home health departments (for England, Wales, Scotland and Northern Ireland) are keen to ensure that good practice developed in one project is available to other projects. With their support, in October 1998 the Healthcare Computing Group at the University of Portsmouth launched the UK National Database of Telemedicine (NDTM) at URL <http://www.dis.port.ac.uk/ndtm>. NDTM currently has a readership that averages over 400 readers per week. Since the launch of NDTM, however, we have come to realize that information about projects is not the only resource about telemedicine that is useful. There is also information about: – companies that provide telemedicine products or services; – people in the telemedicine community either as practitioners or as experts in the technology; – resources such as books, journal articles and websites on the subject; – more detailed information about particularly significant initiatives, which in the UK, includes projects such as NHS Direct and the DERA Virtual Hospital In conjunction with the British Library, we are launching a major new online service, the UK Telemedicine Information Service (TIS), to include all of the above and other information that becomes available. This service will be launched in October 2000.

*Materials and methods:* The TIS is implemented using an Oracle database and PL/SQL programming tools. The features of Oracle that influenced us to select it are that: – It is a well-known product. – We can use standard interfaces to the database including SQL (Structured Query Language) and ODBC (Open Database Connectivity). This would make the transition to another database product relatively easy should we ever have to. – We can dynamically generate web pages from the contents of the database using a variety of products. We use PL/SQL, but could just as easily use other products including Allaire Cold Fusion, PHP and Perl (the latter two being freely available). – We are not tied to products that are available from only one company, or on one operating system platform. – The solutions we have adopted are easily scalable should the size of the database or the number of accesses to it increase significantly. Oracle is available on a number of platforms and therefore we have, if necessary, an upgrade path that could involve moving the database to a faster machine.

*Results:* The TIS website will be demonstrated at the conference.

*Discussion:* We expect that clinicians, managers, IT professionals and researchers will be the main readers of TIS, but that it will also be of interest and relevance to patients and the public. It is intended that the service will be continuously developed and that it should be pro-active in seeking out new information, ensuring the validity of existing information, and in providing facilities for users. The technologies we have chosen contribute to the achievement of that aim. By making information about telemedicine easily available, we hope to encourage its expansion and most effective use as a means of healthcare delivery.

*Keywords:* telemedicine, information services.

### **SNOMED RT: An International Terminology Infrastructure for Clinical Internet Applications**

D. Aschman

*SNOMED International, 325 Waukegan Road, Northfield, IL 60093, USA*

*Introduction:* This presentation describes how an Internet-based infrastructure using SNOMED as the clinical reference terminology can help health care providers and patients collect and share information needed for quality care whenever and wherever its needed. More specifically, it will discuss how such a standard terminology will provide internal consistency within a web-based electronic health record, facilitate information exchange over the Internet and support web-based clinical data repositories for population based health studies.

*Materials and methods:* SNOMED RT, a concept based reference terminology, was beta tested during 1999 and the first half of 2000. This test involved 40 organizations. Case examples will highlight the use of SNOMED Internet applications such as an online personal health records for citizens, a web-based, multi-institutional autopsy database, and a targeted international, electronic consumer health information and news service using a process that supercedes the limits of key-word based routing.

*Results:* Application developers reported that SNOMED RT's organization and content greatly facilitated the reliable aggregation and retrieval of clinical information. (1) More precise documentation of clinical events; (2) Autoencoding from text; (3) Complete and consistent retrieval of related findings, diagnoses, and treatments among users and across clinical specialties; (4) Triggering of guidelines and reference sources using SNOMED metadata tags.

*Discussion:* The discussion will highlight features of SNOMED RT that benefit e-health systems. These same benefits will be enhanced by SNOMED Clinical Terms; a work arising from the agreement to develop a joint terminology from SNOMED RT and the Clinical Terms Version 3 (the Read Codes). This international collaboration will impact E-health by combining the best elements of two independent and comprehensive terminologies. Included will be a comparison of the structures and content of both the source terminologies and will highlight their similarities for example: the distinction between terms and concepts, the use of common codes across different languages, the use of subsets, the representation of relationships (including hierarchical) in simple relational tables, and the provision of formal semantic definitions.

*Keywords:* clinical reference terminology, SNOMED RT, SNOMED CT, information storage and retrieval.

### **Constraints on the free flow of information about outbreaks on the Internet: the ProMED-mail experience**

J. Woodall, C.H. Calisher

*Federal University of Rio de Janeiro, Cidade Universitaria Rio de Janeiro, RJ 21041-590, Brazil*

*Introduction:* The Internet has provided the capability of much faster reporting of outbreaks and much wider dissemination of these reports, both of which lead to improved epidemic prevention and control. But advantage is not always taken of this capability, for a variety of reasons. This paper reports what ProMED-mail, an Internet outbreak reporting list, has discovered over the course of 6 years to be some of those reasons.

*Materials and methods:* ProMED-mail is an independent, free of charge e-mail list reporting outbreaks of emerging infectious diseases from around the world (<http://www.promedmail.org>), with currently 20 000 subscribers in 150 countries, that has been operating since 1994. It has a voluminous e-mail correspondence with its subscribers, plus occasional face-to face meetings at biomedical science conferences between its staff and readers.

*Results:* ProMED-mail has found the following reasons why people do not report about outbreaks about which they have information. One is indifference – people like to read about outbreaks but don't report them. Then there is reluctance – some people are embarrassed to report in such a public forum. Copyright of wire service reports, potential legal liability (e.g. in the case of indicating a source of food-poisoning that later turns out to be innocent), and institutional reluctance (e.g. hospitals do not want their antibiotic resistance rates publicized) are also considerations. There are also government restrictions. WHO and CDC cannot report outbreaks without clearance from the country or state concerned, which may be delayed or never forthcoming. Direct government interference in the free flow of outbreak information over the Internet has also occurred, with the imprisonment of a physician in Cuba for reporting on a dengue epidemic there, and the threat of imprisonment of a pediatrician in Malaysia for releasing clinical information on fatal cases associated with an enterovirus-associated epidemic.

*Discussion:* Happily, there are signs that some of these constraints may be crumbling. ProMED-mail now receives reports directly from hospital doctors about cases of hemorrhagic fevers, from national health laboratories about diagnoses, and from WHO specialists in developing countries about outbreaks in their areas. The moderator of its sister list in Portuguese and Spanish, ProMED-PORT, is a state health department employee in São Paulo State, Brazil, who has access to the latest outbreak information in that country. So the situation is improving, albeit slowly.

*Keywords:* Internet, outbreaks, infectious disease, government, constraints.

## **Structured Data Management and Electronic Communication for Internet Based Virtual Health Record Environment**

P. Sweeney

*Human factors, Research Unit, Electronic Health Records – Structure & Content, The Medical Centre, Dungloe, Co Donegal, Ireland*

*Introduction:* The shortcomings of paper based healthcare record systems are well documented. Failure, however, to adequately address the distinct dislike to typing among the doctor user group could prove costly in terms of efficiency, accountability and quality healthcare delivery. There is an urgent need to collectively address the human computer interaction needs of both healthcare professionals, clinicians and their support agents that better exploits the power and efficient that computers, IT and Internet communications technologies have to offer the healthcare industry in the interest of total quality healthcare delivery.

*Materials and methods:* The revelation in spring 2000 that less than three percent of clinicians in the USA use computers outside the hospital environment is a significant statement about the need for simplifying data entry in clinical record systems. A rural practice in Ireland has been researching the human computer interaction factor since 1994 in an effort to simplify data entry in the electronic health record by the doctor user group. Radical change is proposed in record processing and data management based on a doctor's education, training and clinical management skills. The proposed application offers a short learning curve for this dedicated user group and a reduction in input device manipulation by the user in the order of ninety percent.

*Results:* A record processing and data management system that makes provision to anticipate the data entry needs in defined elements, messages and statements of a dedicated health record has been found to be highly acceptable to many of the computer novice doctor user group. This approach has been made more acceptable when the basic requirement from the doctor is to be able to define both the patient's reason for encounter and the most likely cause of the health related problem. The appropriate structure for partitioning Episode-oriented record processing that makes provision for Practice-oriented decision support has been found to be hugely significant in anticipating structured data entry in definable elements of the electronic patient file.

*Discussion:* Research has identified a need to simplify the human computer interaction factor for the doctor user group in order to get them to better exploit the power and efficiency that computers, Internet and communication technologies have to offer the healthcare industry. The development of a dedicated application is proposed based on a doctor's training and clinical management skills rather than any computer know how or typing skills. The development for such applications can be customized for use by all doctors and clinicians providing services at dedicated points of care. Advanced modules make provision for a virtual health record to reside within dedicated work stations as well as secure Internet repositories so that when required data can be made available to dedicated users, on a need to know basis, to minimise the risk in decision making at defined points of care.

*Keywords:* Medical Informatics Applications, Medical Record Systems, Type free data entry, Internet based healthcare records.

### **An XML and Ontology Based Methodology and Authoring Environment for Medical Information Systems**

D. Roesner <sup>a</sup>, U. Duerer <sup>b</sup>, H.-D. Esperer <sup>c</sup>, A. Moore <sup>d</sup>, G. Parr <sup>d</sup>, M. Logan <sup>d</sup>, K. Zieger <sup>a</sup>

<sup>a</sup>*Institut für Wissens- und Sprachverarbeitung*, <sup>b</sup>*Universitätsklinik für Dermatologie und Venerologie*, and <sup>c</sup>*Universitätsklinik für Kardiologie, Otto-v.-Guericke Universität Magdeburg, Univ.platz 2, Magdeburg, Germany*, <sup>d</sup>*University of Ulster at Coleraine, UK*

*Introduction:* In the EU funded project CATCH II: Citizens Advisory System based on Telematics for Communication and Health (4th FP, HC 4004) a methodology has been designed for the process of developing and integrating multimedia information resources about medical topics. The methodology has been developed in such a way that these information-rich resources have a high potential of reusability and that they allow for the flexible tailoring of the content to suit a variety of applications and environments from a single pool of information objects.

*Materials and methods:* The approach taken in CATCH II is based on a strict separation of issues of authoring and structuring textual information objects from the issues of delivery and providing for flexible configuration into specific application systems. As the formal basis for this approach the Extensible Markup Language XML has been chosen. Based on an analysis of medical authors' and end users' needs, CATCH II has designed and implemented a prototypical authoring support environment that – based on an elaborate ontology – allows authors of medical information to concentrate on their core business: the creation and structuring of information objects in an easily managed environment. From the pool of annotated information objects created by the authors a variety of information offers can be configured. In CATCH II both Internet based systems as well as public information terminals ('kiosk') have been deployed, validated and evaluated with end users in a number of European countries.

*Results:* CATCH II has developed a methodology for the life cycle support of information objects based on enriching documents with metadata, structural markup and semantic inline tagging. Two

authoring environments were developed, CEdit a Java Applet and ConText (a downloadable plugin in VB Script). This paper will concentrate on the CEdit authoring environment which has been made available to medical specialists from outside the project and their feedback has been recorded (with SUMI questionnaires) and evaluated.

*Discussion:* Typical users of the CATCH II results (methodology and authoring support tools) will be all types of organizations providing health related information via 'new media' (e.g. health care authorities, hospitals, insurance companies, self help groups, etc.). In a number of dissemination activities we have informed representatives of such organizations and other potential authors about the potential of CATCH II. This process is ongoing, the feedback gained is very encouraging, particularly in Germany and Northern Ireland. System availability: The CATCH II authoring environment can be accessed and tested via the URL <http://catch.cs.uni-magdeburg.de/CEdit/index.html> with a guest account (user: guest, password: visitor). The authors would welcome feedback from visiting users.

*Keywords:* Health information, XML, metadata, ontology, authoring support.

### **The Medical Practice Website**

J.W. Van der Slikke, L. Loimer

*Free University Amsterdam, Department of Obstetrics & Gynaecology, Postbus 7057, 1007 MB Amsterdam, The Netherlands*

*Introduction:* There will be a time (and perhaps earlier than one might think, that a practice-website will be as normal (and as necessary) as telephone and fax nowadays. However for this moment in Europe these sites are still rare. In this paper we want to give a state of the art in the Netherlands anno November 2000, and compare this to other countries within and outside Europe.

*Materials and methods:* We tried to find as much as possible medical practice websites in the Netherlands, by searching the web, linking from medical portals, patient organizations and national medical societies. We sent an email survey to the webmasters of these sites with some questions as: How did they start? Who built their site? Did they encounter legal problems? How do the patients react? Most important advantages? Most important problems?

*Results:* At the time of submitting not all questionnaires have been sent back. Some advantages as experienced: – The doctor can announce the consultation hours, a map to guide the patient to his practice and other organizational information. – Patients can make an appointment and can ask for a refill of their prescription. – The doctors or their practice nurse can answer questions asynchronously. Some disadvantages: – In Europe the density of Internet users is not yet as high as it is in the USA. – After a good start it appears difficult to keep the content up to date. – Sometimes colleagues consider a web page as not permitted advertising.

*Discussion:* The number of medical practice websites in Europe is still very limited. The doctors who have their practice homepages on line are true pioneers: they invented the wheel themselves. There they encountered many problems, starting from "how to build a site" to "how to maintain it". Another problem many of them forgot was to advertise their site. Some suggestions will be given how to do this. As soon as societies or third parties start to offer website-services, the number will rise. However then it could be difficult for the doctor to stay independent of the organization or independent of sponsors, like pharma industries. Some more practical tips and tricks, partly collected from the survey, will be given. The conclusion is the same as the introduction: There will be a time (and perhaps earlier than one might think), that a practice-website will be as normal and as necessary as telephone and fax nowadays.

*Keywords:* medical practice website, patient education, Internet, World Wide Web, Portal site.



## **Ethical Codes for Internet Health Information – Consensus in the Horizon?**

K. Lampe, P. Doupi

*FinOHTA/STAKES, STAKES/FinOHTA, P.O. Box 220, FIN-00531, Helsinki, Finland*

*Introduction:* Health related information constitutes a significant proportion of Internet content, due to scientific and professional needs on one hand, and commercial and consumer motives on the other. Scarcity of peer review and easiness of publishing has resulted in great variability in the quality of health related web pages. The uncontrollable and rapidly changing nature of the Internet has hindered most traditional efforts to control published material. One of the few feasible means of promoting reliable health information has been to influence the publishers. This has mainly been accomplished by creating ethical rules or codes of conduct. Some of these, such as the Health on the Net Foundation's Code of Conduct (HONCode) have existed already for several years, and have thousands of users, whereas others have been compiled very recently. This multiplicity of initiatives, although indicative of the significance of ethical issues, carries also the risk of fragmentation of efforts. We aimed to explore whether a consensus on ethical principles can be achieved, by contrasting in detail the currently available ethical codes and identifying the areas of overlap or divergence between them.

*Materials and methods:* We reviewed major ethic codes aimed at publishers of health information and compared their scope, principles and feasibility. In contrast to the multitude of various quality criteria sets for health information, only few ethical codes for publishers have been proposed. Until recently, only the HONCode had achieved a relatively wide spread audience, both in terms of health information publishers, as well as users. During year 2000, three new guidelines were published, reflecting the ideas of three distinct interest groups: a) a scientific society – the American Medical Association b) a collaboration of scholars and companies – the Internet Healthcare Coalition and c) a consortium of 'dotcoms', the Health Internet Ethics Coalition. Using the oldest of the codes, the HONCode, as the "golden standard", we assessed the extend to which new rival codes have identified with its principles, whether there are key areas of attention which the various codes share and what are the novel viewpoints they have introduced.

*Results:* The new codes are more comprehensive and detailed than the HONCode. Although differences exist, both in terms of content and of emphasis placed on different principles, the core ideas of all codes take into account similar entities. All codes address issues related to editorial policy, as well as to quality or "truthfulness" of the information. While the former is more easily defined and transparent, the latter gives reason for considerable further refinement.

*Discussion:* A relatively widespread consensus on the core ethical principles for health information providers seems to exist. However, current ethical codes are prone to mix simple and easy-to-follow policies with more controversial and thus less tractable entities, such as quality of information or balanced information. The latter concepts are often vaguely defined and require further deliberations within the health information provider community, as well as contribution from the viewpoint of end users. Moreover, it is important to recognize that little information is available so far regarding the actual impact of ethical codes, both on the practices of health information providers and on the truthfulness and usefulness of the end product (the health web sites themselves).

*Keywords:* Health Information, Internet, Ethics, Codes of Contact.

## **Internet & Electronic Medical Records in Dutch Burn Care Units**

P. Doupi

*Erasmus University Rotterdam, 50 Dr. Molenwaterplein, PO Box 1738, 3000 DR, Rotterdam, The Netherlands*

*Introduction:* The advent of Internet technologies in health care creates novel opportunities for the exchange, sharing and aggregation of clinical data originating from geographically disparate locations. This potential is of particular interest for a field such as burn care, where the small number of patients treated per unit makes pooling of data an imperative for performing research. In this context, standardization of data collection, and of clinical narratives in particular, is a necessary step. The Dutch Burns Foundation, in collaboration with the Medical Informatics Department of Erasmus University, has taken a leading role in promoting and coordinating the use of a common, Internet-enabled electronic medical record (EMR) in burn care facilities in The Netherlands. In this paper we present the approach we adopted in developing the interface to a structured electronic medical record for burn care, we identify the main challenges and suggest future areas of research.

*Materials and methods:* We developed an interface for structured data collection in burn care by using the Open Record for CARE (ORCA) set of engineering tools for the development of domain-dedicated EMRs. The Knowledge Editor component was used to model burn-care specific knowledge, which supports the 'intelligent', predictive behavior of the interface. In an exploratory phase, we created a version limited to hospital admission data, based on the Emergency Management of Severe Burns data collection protocol. Consequently, we expanded the system to accommodate recording of all data pertinent to the summary description of a burn patient case. The data set of the Dutch Burns Information System (NBIS) – the backbone of the Dutch Burns Registry, a national research database-served as the point of reference in order to facilitate future interoperability of the two systems.

*Results:* We aimed to create a flexible, user-friendly interface, while at the same time respecting the restrictions imposed by formal representation of medical knowledge. Maintaining the balance between the two posed as the central challenge in the development process. The NBIS data set, being the product of prior consensus forming between representatives of all burn care centers, provided valuable aid in guiding our efforts without posing further demands on clinician time. Collaborating experts have positively accepted the core, main version of the structured data entry interface. Furthermore, the functionality of the software allowed us to accommodate local variations in recording styles between the burn care units.

*Discussion:* The combination of promising, innovative technologies such as EMRs and the Internet holds the promise to revolutionize research, as well as clinical practice. We intend to explore further the applicability of these developments in improving care for burn patients in the Netherlands. In the near future, the structured data entry interface we developed will serve as a data collection tool for research purposes. We shall study the feasibility of using clinical data contained in the electronic medical record to personalize online health information, as a strategy for customized patient education and support.

*Keywords:* Data Collection, Medical Records, Burn Units, Internet, Patient Education.

### **WebSET: Integrated XML and VR Components for Collaborative Medical Training on the Web**

A. Emmen, N. John, L. Versweyveld

*Genias Benelux, James Stewartstraat 248, NL-1325 JN Almere, The Netherlands*

*Introduction:* The WWW has been advocated as a possible basis for a cost-effective training environment. Most efforts to date, however, only explored the possibilities by building ad-hoc HTML trainings sets. With the emergence of standards like XML, and VRML/X3D and the experience gained with previous experimentation, it is now possible to build a modular extensible training package that can be used to increase the cost-effectiveness of training. In a European project, called WebSET (Web-based Standard Educational Tools) and partially funded by the European Commission's IST

programme, the WebSET training package is being developed, including modules for surgical training as starting point.

*Materials and methods:* To achieve the goal of an advanced web-based cost-effective learning platform, WebSET is – developing technology that is widely applicable and demonstrated by applications in surgery training by the Imperial College School of Medicine at St. Mary's and the Leeds General Infirmary in the UK and a general medical training application from the Ministry of Education and Sport in Slovenia. – Develop a cost-effective and widely available training package with generic technology components that can be integrated in collaborative training packages. – Identify a standard taxonomy for surgical learning and associated metadata for surgical learning objects. – Evaluate the training package in hospitals and schools – Developing an e-commerce outlet The WebSET functional architecture is on a component, serving a learner/trainer through a browser. The component consists of a multimedia-interface with 3-D view and interaction, a physiological simulator, knowledge acquisition and a collaboration engine. Each learner can make use of WebSET alone, without interacting or through interaction with other learners and teachers. The collaboration engine technology underlying WebSET is based on a previous developed collaborative environment called DeepMatrix which demonstrated this type of interaction is possible over the WWW even with not very fast connections. The physiological simulators are written in Java. All the text material and the infrastructure will be based on XML. Several tools have been identified that can help with the development of the material and infrastructure. However, the very nature of a good XML-infrastructure, allows to exchange them when needed. The visualization and interaction components are based on VRML and X3D. There are two main medical training applications that will be developed using WebSET: – A neurosurgery training, where a procedure is chosen for catheterization of the lateral ventricle of the brain. It is a procedure which junior surgeons need to learn relatively early in their training. – A general surgery training involving an enhanced simulation of a lumbar puncture procedure.

*Results:* WebSET is a two-year project, started earlier this year. The first phase of the project, with a technology survey of the state-of-the-art and detailed descriptions of the user requirements of the system and the surgical models to implement are available. Currently the first prototype is being developed.

*Discussion:* In this paper we described the design and first implementation steps of WebSET a collaborative modular training environment for surgical applications.

*Keywords:* collaborative learning, medical training, virtual reality, World Wide Web.

## **Redesign of the Virtual Medical Community Portal Site – Experiences With Application and Integration of XML/XSLT Software**

A. Emmen, L. Versweyveld

*Genias Benelux, James Stewartstraat 248, NL-1325 JN Almere, The Netherlands*

*Introduction:* The Virtual Medical Worlds Community's (VWMC) web site is a portal for advanced IT for medical applications with physicians, researchers and IT specialists amongst its readers. Although highly specialized it attracts 5,000 visitors each month. The original site was based on SGML and programmed in Perl and Javascript. The portal has been completely redesigned, centered around XML DTD's. The system is completely implemented in Java using publicly available XML-tools written in Java. The main system is implemented using Java servlets. Several supporting tools are available as stand-alone applications. Despite the rapid development in XML-tools, still lot of Java programming and stylesheet development is needed to implement a specific portal.

*Materials and methods:* The Virtual Medical Worlds Community (VMWC <http://www.vmwc.org/>) portal site includes: The VMW magazine, a monthly digest on advanced IT for medical applications, with a focus on telemedicine, VR, large databases and Internet technologies as XML. It is available on the web and per e-mail. It also provides partner profiles, project descriptions and more. The new portal site is much easier to maintain. The original web site, that started in 1997, based on SGML technology, and implemented in CGI, HTML, Perl and Javascript. The new community is implemented using XML, XSLT, Java and Servlet technology. All the interfaces are available through a browser, but a number of functions are also available as stand-alone Java applications. All information in the system is kept as XML-documents. The core is provided by the VMP Document Type Definitions (<http://www.hoise.com/vmp/>) that provides a description of the structure of each information item (news article, organization profile, project description, etc.) additionally there are descriptions for subscribers, and access control for authors and editors and site set-up. A regularly updated part of the VMWC is the VMW magazine, published each month on the web and sent to subscribers by e-mail. The individual articles are stored in XML files created by the VMP authoring/editing tool. This is a Java application implemented as a stand-alone authoring tool and as part of the web site as a Java Servlet. Document checking is done by an XML-parser integrated into the system. The html for display are created using XSLT stylesheets. The Editor-tool provides the interface for managing the publication process. The editor also has a subscription management system for maintaining subscriber information and sending the e-mail version of the magazine. The project web sites (several medical research sites are included) are created using the standard VMP Authoring tool. A set of stylesheets then generates the web site from these files. Creating a site for a new project is easy, because all the layout information is located in a few places in the templates.

*Results:* The old software has been replaced during the past year with new XML/Java components. This has made the production of the VMWC portal much easier. The sets of stylesheets for maintaining project web sites prove useful to set up new web sites.

*Discussion:* In our experience XML combined with XSLT can be used to create complete web sites, and other documents fairly easily. Writing html directly is a thing of the past. For user-interface, document management and subscription service, additional technology is needed. Java and ava servlets turned out to be enough in all cases.

*Keywords:* portal site, medical communities, e-publishing, XML, XSLT.

### **Advanced Information Management for Health Care in Regional Context Using Reference Models and Internet Technology**

G. von der Weiden, M. Haischer, A. Weisbecker  
*Fraunhofer IAO, Nobelstrasse 12, D-70569 Stuttgart, Germany*

*Introduction:* Every larger health service in Europe suffers from an increasing amount of pressure which is caused by the fact that already now resources are scarce. Now a majority of the arising costs is spent on longer-term care of complex disease treatments such as diabetes, dementia or cancer, during which the patient is treated by different health care providers for a longer period of time. For the German health service studies prognosticated saving possibilities at a value of 30% of the entire outputs by an improved co-operation of the different health service providers and an optimization of the appropriate information management. In project "VerKet" (funded by the federal Ministry of Education and Research) concrete possibilities for technical support between different types of health care facilities were examined. The referral of Patients is almost always bound up with medium breaks, double entries of data and an unnecessary large number of examinations. Our own investigations

revealed that, for instance, when a patient is accommodated in a hospital to have a heart catheter treatment, 20 of a total of about 40 minutes are spent on the acquisition and the transfer of available data on paper-based forms.

*Materials and methods:* Given the complexity of a long-term treatment by several types of health care providers the referrals of patient are especially critical, where not only the person itself but also its documents and information about the past treatments should be correctly transferred. As an example for this type of problems in our project the accommodation of a patient into a hospital for a heart catheter examination was examined and optimized. For this reason all information and documents regarded as necessary by doctor in the hospital were collected and evaluated. On this base a form was developed, which the transferring physician can fill out already before the referral of the patient to the hospital. This document contains specification to the date and the results of past examinations and reminds the physician of issuing certain medicines, with whose application the examination cannot be executed in the hospital. The form is already prepared for fax dispatch directly to the hospital station (it is saved in PDF-format) and can be filled out and dispatched alternatively also electronically, since this is integrated into a complete information system which is programmed using HTML-code.

*Results:* By using these forms timesavings in the referral procedure of over 50% can be achieved, as first practical evaluations could show. The quality of the information and the information transfer itself could be substantially increased. By the physicians in the hospital fewer missing documents were determined than before. By remembering of issuing several preparations had to be called off substantially fewer examinations. Beforehand those patients were transferred to hospital for one day longer than necessary (at additional costs) or were sent home again. These advantages led to more time available for individual patient care. As most positive effect the high use of such documents was regarded compared with the relatively small effort to their creation. Once if a form is created by a station of the hospital, this can be sent to all transferring physicians. The information system contains also additional documents for patients about treatments in individual phases. The work flows used in this system are based on uniform reference models for patients and treating health care providers, so that between both views can be changed in each case at any time.

*Discussion:* Encouraged by the positive experiences with the actual results and the positive reactions of the users in all institutions the system is actually extended to additional stations and disease treatments. The procedures for the creation and revision of the transfer documentation are evaluated once more at present, in order to make these experiences also usable for future users. This concerns also procedures for the supply of electronic documents on CD ROM or for downloading them by Internet. A general Internet-based communication appears possible in medium-term, it fails so far because of the different regulations of data security and the missing technical configuration of some facility types. An advancement of the presented solution on electronic data communication would let implement additional advantages regarding the general availability of diagnostic and therapy information.

*Keywords:* Public Health Administration, Health Services Administration, Organizational Models, Reference Models.

### **Telemedicine and Elderly Care: Towards an Internet Blood Pressure Monitoring System**

J.S. Briggs, C.J. Fitch, R.A. Beresford

*University of Portsmouth, 1-8 Burnaby Road, Portsmouth, PO1 3AE, UK*

*Introduction:* The use of the Internet to assist care in the patient's home is becoming more widespread. The technological advances now taking place and predicted for the future make this an increasingly likely development. The project described here is an investigation into the implications of using the Internet to support elderly care. We have focussed on a system to monitor at home the trends in blood pressure of older patients. The investigation is in three parts: 1. Firstly, to ascertain the attitudes of older people towards the use of information and communications technologies (ICT) in elderly care, and whether they are prepared to use such technology to aid the delivery of their care. 2. Secondly, to ascertain the requirements of healthcare professionals (HCPs) for a blood pressure monitoring system. It is crucial to its effectiveness that it provides information in a way and form that allows professionals to do their job. 3. Thirdly, a technical investigation into how Internet technologies can be used to transmit the necessary data with desirable attributes such as reliability and security. This paper describes part one.

*Materials and methods:* To ascertain the views of older people we conducted two surveys. A small-scale study was done with members of a leisure club (n=13), followed by a larger scale study among patients in three local day hospitals in the Portsmouth area (n=500). For both surveys a postal questionnaire was used. The issues the questionnaire addressed were: – What was the age range of participants? – Does this target population use computers? – If so, what is their primary purpose? – If not, what are the reasons for this? – What activities and interests do participants have that might influence their computer use?

*Results:* So far, only the results of the first survey have been analyzed. These show that cost, difficulties with technology and lack of system user-friendliness are not major obstacles to access and ownership of computers amongst this segment of society. Almost half of the respondents own and regularly use a computer. The computers are used for hobbies, household accounts, club activities and so on, and by half the users for email and exploring the World Wide Web. From the comments provided during this survey, a major concern for the respondents is the fact that technology may replace the opportunity for face-to-face interaction with their health care professionals (“people need the personal touch”, “was it really a doctor there, or a clever computer?”, “worried we are becoming dependent on only a few human beings rather than the majority”). Not understanding the technology was a contributory factor, but not a major obstacle to computer use. The primary concern for the respondents is that the technology may become mandated, and replace the opportunity of face-to-face interaction with their health care professionals. Results of the second survey will be available for presentation at the conference.

*Discussion:* Although we are in the very early stages of evaluation of this Internet care system, indications are that blood pressure monitoring in elderly care can be supported by using the Internet in a safe and secure way. Both home users and HCPs are positive about the system. We should bear in mind that, just because we are now technically able to offer greater support for health care delivery using ICT, it does not automatically follow that it should be adopted without asking questions about its suitability. Monitoring which may be suitable for some patients will not be appropriate for others. Not all medical specialties will lend themselves to this sort of approach.

*Keywords:* telemedicine, elderly care, Internet.

### **Applying the 3-D Wavelet Transform to Transmit Medical Video in Telemedicine**

G. Bernabé, J. González, J. García, J. Duato

*Universidad de Murcia, Facultad de Informática, Campus de Espinardo, 30080 Murcia, Spain*

*Introduction:* In the last few years, the growth of the Internet and World Wide Web (WWW) has been very large. Nowadays, it is known that Internet becomes the most important communication medium of any future information society. On the other hand, Telemedicine is expanding rapidly and its usage is becoming a global interest. Therefore, it is clear that the development of Telemedicine should be combined with the increase of the Internet. An important and real benefit of telemedicine is that more than one practitioner can telecollaborate. Due to the huge amount of transmitted data, high-bandwidth networks are needed in order to maintain the quality of the video and allow a correct and precise diagnosis when it is reconstructed. Therefore, we have focused our research on the compression of medical video sequences. The standard MPEG-2 presents several drawbacks. The Fast Wavelet Transform (FWT) has emerged as an attractive alternative. In this work, we present and evaluate a new lossy video compression scheme, based on the use of the 3-D wavelet transform and focused on medical video sequences.

*Materials and methods:* We propose a new coding scheme for 3-D wavelet, which exploits both the spatial and the temporal redundancies. We have proved and evaluated different wavelet mother functions such as Daubechie's  $W_4$ , Haar and Daubechie's  $W_8$  in order to evaluate the impact of the mother function on final performance. In addition, we have been evaluating the number of steps that this function is applied to choose the best trade-off between the quality/compression rate. We also propose two ways of thresholding: the percentile policy and the discarding of the less significant bits of all wavelets coefficients. We propose a quantizer where the number of bits needed by each pixel coefficient to be encoded depends on the layer that this pixels belongs to. Finally, an entropy coding is performed: a run-length and a Huffman compression is carried out to the coefficients.

*Results:* We have compressed and decompressed various medical video sequences. Our results range from compression rate of 9.46 and 44.54 dB (PSNR) with  $W_4$  wavelet mother, percentil-95, two wavelet transform and two less significant bits discarded, to compression rate of 19.25 and 41.41 dB (PSNR) with the former wavelet mother, percentil-98, three wavelet transform and three less significant bits discarded.

*Discussion:* The Daub-4 obtains the best trade-off between compression rate and quality. We consider that more than 3 applications of the 3D-FWT are not worthwhile. Analyzing the results for the different percentiles and number of bits discarded we conclude that the more bits and coefficients are discarded the more compression rate is achieved. But an optimal configuration must be chosen in order to obtain a reasonable compression rate without influencing the quality. The compression rate and quality obtained are excellent, which confirms the potential of the 3-D FWT for medical video. Compression rates achieved are quite good, as well as the quality, especially when compared with the compression rate and quality achieve by the standard MPEG-2, with no extra cost in computation time (around ten percent less). Our implementation of Wavelet Transform is more suitable for medical video since images are not divided in blocks, avoiding the presence of artefacts in the reconstructed image. More precisely, this process takes care of the particular details of the video sequences and makes unnecessary the application of softening filters.

*Keywords:* Telemedicine, medical video, high quality, compression, 3-D wavelet transform.

### **CE-Net – UBHT's Intranet Portal to Support Evidence-Based Medicine in A Large NHS Trust**

J. Osborne, M. Palmer

United Bristol Healthcare NHS Trust, Bristol Royal Infirmary, Marlborough Street, Bristol, Avon BS3 2AD, UK

*Introduction:* United Bristol Healthcare NHS Trust (UBHT) is one of the largest NHS Trusts in the UK. In 1997 UBHT launched its Internet site (<http://www.ubht.org.uk>), followed in 1998 with an intranet service. Currently UBHT has approximately 600 PCs or thin clients connected into its intranet backbone, based on Microsoft networking and intranet technologies. Despite all this hectic activity, it was recognized that our intranet had yet to fully serve the clinical knowledge management needs of our clinical staff. In 2000, UBHT launched CE-Net, an intranet portal deliberately focused to the information needs of its clinical users, deliverable in clinical and near clinical areas. The Trust's Clinical Effectiveness Strategy (1999) defined the following aims: – to ensure that all clinical staff and managers have an appropriate basic awareness of the importance of Evidence Based Practice; – to ensure that all staff have access to newly published evidence about clinically effective practice in an easily understandable format; – to ensure that when a clinical question arises about the treatment of a patient, staff have access to appropriate sources of evidence about clinically effective practice; – to ensure that professional staff in each clinical area have an appropriate awareness of research methodology and expertise and that there is a common understanding of research methodology; – multi-professional clinical teams to apply national clinical guidelines locally, developing evidence based guidance for practice, using national service frameworks as they are developed; – to ensure that locally accepted guidelines are widely disseminated CE-net is a locally designed and created intranet portal which supports these aims, explicitly designed to be integral and supportive to the everyday work of staff. As web-enabled PCs are increasingly replacing dumb terminals in clinical and near-clinical areas, CE-net is seen as a cost-effective local solution to a problem which is addressing hospitals across the world – how to support staff deliver clinically effective evidence-based healthcare.

*Materials and methods:* A key issue for UBHT was that the design, creation, implementation and long-term support of the CE-net portal should be 'in-house', using industry-standard tools. It should take advantage of high-speed secure NHSNet links wherever possible. Achieving a low-cost high-quality balance was essential. All PCs and web-enabled thin-clients within UBHT are supplied with Microsoft Internet Explorer® 4 as a standard web browser, together with the Adobe Acrobat® 4 reader. All PCs in clinical areas are supplied with WRQ Reflection® 2 as a standard terminal emulator, to allow access to legacy clinical systems. This standard installation base has allowed CE-net to be developed as a single browser version, aimed at a 800x600 screen display with a color depth of at least 256 colors. CE-net was developed using Microsoft FrontPage® 2000. This single piece of software provides web page and site creation tools, together with comprehensive management tools. By choosing FrontPage we were able to take advantage of the built in support of FrontPage extensions on our intranet server, allowing the creation of feedback forms and discussion groups, without the need to write complex cgi/perl scripting. A full survey of the information needs of clinical staff preceded the design of CE-net. There was a clear need for simple one-click access to key clinical sources such as legacy clinical systems, the British National Formulary, and local clinical guidelines. CE-net has developed so that a top menu bar is always present on screen, giving single-click access to such key information. Another key issue was acquiring access rights to key bibliographic and evidence resources. The Trust has purchased site-wide access as part of a regional consortium to the following key literature sources: AMED, ASSIA, British Nursing Index, Cinahl, Embase, HMIC, Medline, PsychINFO. In addition, there is NHSNet access to the Cochrane Library, and Clinical Evidence (an evidence "formulary" along the lines of the British National Formulary). Its total development time was one day a week, for six months, by a clinical audit facilitator on secondment to the Research & Development directorate.

*Results:* The CE-net home page uses a jigsaw image as a motif for the elements of clinical effectiveness, with the following components: Research & Development, Clinical Audit, Library, Care Pathways, Patient Information, Guidelines, Clinical Skills, Critical Appraisal. Each component



includes a local web site giving detailed information about each subject heading. An omni-present top menu bar gives single-click access to the following: link to main intranet service, on-line internal telephone directory, local guidelines repository, Clinical Evidence, Cochrane Library, WeBNF, Bibliographic databases. The side menu bar leads to key information about clinical effectiveness, and locally derived how-to guides on both searching for and appraising the evidence-base. As part of its launch promotion, CE-net incorporated an online quiz, with a monthly prize of a fully networked PC for a clinical area. The questions were so designed that users had to browse CE-net or do some search of the evidence base to find the answers. Feedback has been overwhelmingly positive, with users appreciating both the localized content and the simple navigational theme of the site.

*Discussion:* As CE-net has developed, it has become clear that UBHT has effectively developed a local version of the UK National Electronic Library for Health (NeLH). We envisage close cooperation with NeLH as CE-net matures into a virtual library, as a potential model for other NHS Trusts to follow. UBHT is currently developing web-enabled access to clinical systems, which will be incorporated into CE-net as a prominent menu option from the CE-net home page. As more and more journals and textbooks become available full text online, we will incorporate access to them from CE-net. In 2004 it is anticipated that our existing legacy clinical systems will be replaced by a comprehensive Electronic Patient Record (EPR). At this stage it is not clear how CE-net will be incorporated into the EPR, but we are convinced that access to the evidence base must be provided, whatever the solution. A key question for the near future is whether we should provide CE-net as an Internet resource, open to all. Finally, creating web sites should not be a triumph for technology, but of content. We have demonstrated that bringing together a cohesive and effective intranet site can be achieved quickly, at low cost, serving a true need within a hospital environment.

*Keywords:* Portal site, Intranet, Knowledge management, Great Britain, Evidence-based Medicine.

### **XML Technology in Support of Clinical Protocols for Teleconsultation**

C.E. Chronaki, P. Lelis, M. Tsiknakis, S.C. Orphanoudakis

*Institute of Computer Science, PO 1385 Heraklion, Crete, Greece*

*Introduction:* As medical teleconsultation is gradually taking its place among healthcare procedures, guidelines and protocols for clinical practice are incorporated to improve the efficiency and effectiveness of teleconsultation services. Furthermore, viewing the lifelong EHR as a collection of documents makes XML the natural choice for the exchange of patient information among healthcare organizations. In the context of a web-based collaboration environment, designed at ICS-FORTH, for integrated problem-oriented GP-to-expert teleconsultation, XML technology has been used to support clinical protocols and provide secure, extensible, customizable, and interoperable teleconsultation services.

*Materials and methods:* Since its adoption as a W3C recommendation in 1998, the eXtensible Markup Language (XML) and a number of related W3C recommendations (Namespaces, XPath, XSLT), notes (XML-Data Reduced), and working drafts (XML-Schema, XPointer, XLink) are shaping the future of the web, providing simple, elegant, and scalable interoperability solutions. In the document-centric world of healthcare, XML's separation of document structure (Document Type Definition or XML Schema) from its presentation (Style Sheets) and its contents which typically reside in a database seems to provide the solution to interoperability of healthcare documents. As a result, committees within standardization organizations in healthcare such as CEN/TC251, HL7, ASTM, etc. are currently working on recommendations for the use of XML in healthcare. The first clinical protocol supported by the teleconsultation system was screening of patients with suspected

acute myocardial infarction and was deployed between primary healthcare centers and a regional hospital in the island of Crete. Following discussions with a working group of physicians and medical experts, the clinical protocol was reflected in a set of customized HTML documents: the request form, diagnostic report, progress note, and discharge reports. Database integration was hardwired and terminology support was virtually non-existent. Thus, the ability to automatically process teleconsultation folders was very limited. The demand for system extensions, support of additional protocols, reusability, and assessment presented XML technology as an attractive alternative to HTML. In the second version of the system, emphasis is placed on scalability, adaptability, reuse, and automatic processing. XML technology provided solution to all of these problems. XML schemas have been designed to reflect the structure of the various teleconsultation documents. Besides structure, the XML schema includes information that facilitates interoperability of the teleconsultation application with the health record archive. Namespaces have been created to identify and document the elements and attributes used in the various documents and link them to terminology sources when appropriate. In this way, documents associated with different protocols share meaningful elements and attributes, while promoting documentation, and reuse, and automatic processing. Finally, XSL templates have been designed to present the documents in an attractive way.

*Results:* The adoption of XML technology for the definition, processing, documentation, and analysis of customized healthcare documents used in teleconsultation demands considerable time in terms of design and development which is gained in extensibility and adaptability. In the context of problem-oriented GP-to-expert tele-consultation services, XML technology has been successfully adopted to support clinical protocols in teleconsultation.

*Discussion:* Electronic healthcare documents may be rendered in many forms such as printed to paper or a computer screen, stored in the tables of a database or transformed into other software representations such as messages or transactions. XML technology emerging from the convergence of data processing, communication, and publishing technology, addresses these issues and presents new opportunities for the representation and exchange of clinical information.

*Keywords:* telemedicine, clinical protocols.

### **Patients-Online: First-Hand Knowledge – from Patient to Patient. First Experiences with the Austrian Prototype ([www.patients-online.at](http://www.patients-online.at))**

H. Ebner, M. Muellner, R. Ernst, K. Schuetz-Mueller

*Koeck, Ebner & Partner, Alserstrasse 4/1/15/5, A-1090 Vienna, Austria*

*Introduction:* How can patients be actively supported in taking responsibility for their health, and in case of illness, for their recovery? How can patients be better involved in the decision making process, and thus in the planning of diagnostics and therapy? A clear change of paradigms is taking place within the relationship between healthcare service providers and patients. A pre-requisite for patients' ability to make use of their new power is the unlimited access to information. In the past few years most internet-services have begun to provide structured expertise in the form of tips and pointers, or newsgroups where direct communication between patients is encouraged. The key deficit that we have found lies in the fact that patients' knowledge and experience in dealing with the healthcare system, as well as their evaluation of healthcare institutions as consumers have thus far been all but ignored as sources of valuable information on the internet.

*Materials and methods:* We reacted to this by creating patients-online, the central element of which being a structured approach to the in- and output of patients' knowledge. Users can access and submit information on more than 100 diagnoses, health-related situations and healthcare service providers in

the form of: tips on dealing with healthcare institutions, patient-rankings of institutions, personal accounts of patients' experiences, and website recommendations. This all bases on an extensive database, which was developed over a two-year period by a team of 40 people. Extensive analyses of newsgroup-communication, patient focus groups, patient interviews, expert interviews and patient questionnaires were carried out in order to produce the more than 25.000 sets of data (patient needs, tips, explanations and questionnaires concerning quality of care).

*Results:* To which extent this instrument will prove successful in empowering patients in dealing with the healthcare system and thus strengthening them in their self-responsibility depends on several factors. The methodological and professional backing of the content as well as the platforms reliability and credibility is the deciding factor as to whether or not patients are willing to input their knowledge and experience. The goal is to implement a methodologically and professionally moderated, but ultimately self-regulatory community, which adheres to all ethical pre-conditions (editorial independence, prevention of misuse, credibility of data, etc.).

*Discussion:* The main question concerning the establishment of such an information-platform is whether or not the implicit and explicit knowledge of patients concerning health, illness, recovery, and mainly on dealing with healthcare providers can be tapped in such a way that the information is uncensored, authentic and self-explanatory on one hand, and structured, methodological and reliable on the other. It is the interaction between these two sources of information (patients and professionals) that promises to provide help and support to other users and patients. Much courage and certainly extensive evaluations of the effectiveness of such initiatives will still be needed.

*Keywords:* Patient Preference, Needs Assessment, Questionnaires, Patient Satisfaction, Quality of Healthcare.

### **Improvement of Diagnostic Accuracy by Use of A New Software System and Distribution of Visual Expert Knowledge via the Internet**

J. Meyrowitsch, M. Høier-Madsen, C. Ingwersen, P. Charles, J. Forslid, A. Wiik  
*Percepton, Science Park CAT, Universitetsparken 7, 4000 Roskilde, Denmark*

*Introduction:* High intra-classifier and inter-classifier variation in diagnostic microscopy and medical image interpretation is known to hamper severely the quality of the medical diagnoses. These variations in intellectual skills and visual acuity are often leading to wrong treatment of diseases, and huge economic and human costs. In a EU supported project named CANTOR (Converging Agreement by Networking Telematics for Object Recognition) educational and training software system named DOORS (Discrete Object Observation and Recognition System) was validated whether it could be used to improve the accuracy of diagnostic image classification in the area of indirect immunofluorescence (IIF) microscopy for detection of antinuclear antibodies (ANA). Screening for ANA by IIF is used worldwide to support the diagnoses of a number of autoimmune rheumatic diseases, but little has been done to harmonize terms, definitions and visual image recognition so far. The EU project explored the DOORS software if it could assist in harmonizing classification rules, construct high-quality image libraries, and localize the visual expert knowledge to be used by converging networking for the visual learning and certification processes of individual classifiers.

*Materials and methods:* In the EU project, DOORS was further developed used to assess ANA pattern recognition capabilities of twelve different skilled laboratory classifiers from three institutions in Stockholm, London and Copenhagen who were exchanging their knowledge databases via Internet. Classification taxonomy was defined containing unique classification labels and precise definitions for each of the 28 positive ANA staining patterns including a reference image for each pattern. 45 training

images and 40 test images of high quality representing these positive staining patterns as well as negative reactions were classified six times during 3-4 weeks as flipped, rotated and in random order to reduce influence of the short-term memory. During training sessions the classifiers memory stamping was supported by the expert knowledge and access to image matching between the training images and the reference images. DOORS was equipped with illustrative graphics, concordance analysis and statistical tools for kappa evaluation of the twelve classifiers agreement with the expert during education, baseline testing, training sessions and final skills testing.

*Results:* By use of DOORS an ANA taxonomy classification was defined, and among several classifiers an expert was nominated. Six non-expert classifiers converged their classifications toward the expert classification. One classifier improved the kappa value by 28% from 0.74 to 0.95, and five other classifiers improved their kappa value between 2–11% in the range 0.84–0.92 to the range 0.90–1.0. Six classifiers remained their kappa values. It was also shown, that one non-improving, inexperienced classifier misclassified systematically the same patterns indicating inadequate instruction from the institution.

*Discussion:* The results shows, that DOORS in many aspects will become a worldwide very useful visual knowledge improving system for medical networking in education, training, quality assurance and standardization of ANA pattern classification. The validated system and the implemented knowledge networking procedures implemented and executed via Internet is expected to become useful also in other visual knowledge networking diagnostic fields for optimized treatment of patients by use of certified visual knowledge for improved diagnostic image classification. Localization and use of certified expert knowledge will in diagnostic imaging surely open new avenues for recognizing and diagnosing new diseases by new visualization techniques approved by certified expert classifiers.

*Keywords:* Computer Communication Networks, Distance Learning, Diagnostic Imaging, Classification, Visual acuity, Standardization.

### **TeleCardio-FBC: an Application of Telemedicine for Cardiology**

K. Villela, M. Montoni, J. Blaschek, A. Rocha, A. Rabelo Jr

*COPPE Sistemas, Federal University of Rio de Janeiro, Ilha do Fundão, Rio de Janeiro, RJ, CX 68511, CEP 21945970, Rio de Janeiro, Brazil*

*Introduction:* There is a trend to move health care closer to citizens so that the time, costs and inconvenience of transporting patients to specialized health centers can be reduced. However, the costs to keep specialized staff and equipment where medical assistance is needed are too high. Telemedicine offers an answer to the strategic challenge of providing better services to citizens, by increasing access to specialized and high-qualified medical services while minimizing costs. Yet, the absolute cost of a telemedicine project may render it unfeasible. In this context, Internet has played an important role enabling the use of telemedicine systems by units that cannot make significant investments in telecommunication infrastructure and in computational resources. The Unidade de Cardiologia e Cirurgia Cardiovascular/Fundação Bahiana de Cardiologia (UCCV/FBC) is part of a University Hospital and acts as a cardiology reference center for the Northeastern region of Brazil. Thus, TeleCardio-FBC is a telemedicine system developed to enable cardiologists at UCCV/FBC to cooperate with other physicians, cardiologists or no cardiologists, helping them to make diagnosis of cardiovascular diseases and to prepare their patients' therapeutic plan, and helping them in the follow-up of patients hospitalized at UCCV/FBC that, after discharge, have returned to their hometowns.

*Materials and methods:* The system characteristics were defined after research was carried out on telemedicine, computerized patient record and cooperative work. A prototype of the system was built

in order to analyze system construction feasibility, improve the understanding of the problem and to have a first version that could be assessed by cardiologists. The next steps were the definition of features and quality characteristics required for the system, its modeling and implementation. The system was modeled using UML (Unified Model Language) and implemented using Active Server Page. It is now being evaluated at UCCV/FBC. Initially, the following issues are under analysis: (1) usability, (2) completeness of the information forethought in the computerized patient record, and (3) minimum impact on doctor patient relationship.

*Results:* TeleCardio-FBC has 5 modules (Patient Medical Record, Patient Referral, Remote Consultation, Continued Medical Education and Information to Patients). It has the following characteristics: (1) computerized patient record model especially defined and implemented for use at the office and that combines structured and free text information, (2) interface to minimize the navigation and paging, allowing physicians to quickly see the evolution of the information registered in the patient records throughout different appointments, (3) unique patient identification, (4) support to cooperative work, (5) store and forward approach for remote consultation with the possibility of synchronous communication, (6) use of the Internet and dialled and private telephone lines, (7) enforcement of the National Research Council (NRC/EUA) security recommendations.

*Discussion:* The system will provide specialized medical care in cardiology for patients who live far from metropolitan areas, reducing costs involved in the displacement to reference centers and, enabling better follow-up of discharged patients who have returned to their hometowns. The significance of this system for the care of cardiology patients in the Northeast region of Brazil should be highlighted.

*Keywords:* Telemedicine, Remote Consultation, Computerized Patient Record, Cooperative Work, World Wide Web.

### **Towards Internet-Based Epidemiology: Integration of Distributed and Heterogeneous Clinical Data Sources**

G. Potamias, C. Christofis, M. Tsiknakis, S. Orphanoudakis

*Institute of Computer Science, FORTH, Vassilika Vouton, P.O. Box 1385, GR-71110 Heraklion, Crete, Greece*

*Introduction:* The ultimate goal of epidemiological studies is health prevention, and health prevention is highly dependent on information transfer. In the context of Internet, and WWW-based communication the key-features that determine the future of epidemiological methodologies are: data collection from distributed data sources (e.g., remote clinical information systems), and immediate access to summary data. Besides collecting enormous amount of data, the inevitable and important challenges in the course of founding and automating Internet-based epidemiological studies are: (a) semantic integration of heterogeneous data sources, and (b) knowledge discovery (or, data mining) from these sources- with the discovered knowledge constructs to represent potential and interesting epidemiological findings. This paper presents the problem of discovering and acquiring knowledge form distributed and heterogeneous- D&H clinical data sources. We tackle the problem of inducing interesting associations (i.e., association rules) between data items stored in remote clinical information systems. The test-bed environment of our approach is HYGEIANet: The Integrated Health Care Network of Crete.

*Materials and methods:* The critical operations of the elaborated multi-phase data mining procedure are: (1) efficient access to structured and distributed data sources – a Patient Clinical Data Directory server links distributed patients' encounters; (2) reliable homogenization and integration of

heterogeneous data – a dedicated medical data-model, and medical ontology are appropriately utilized; (3) effective and reliable data mining (or, knowledge discovery) operations – an association rules mining algorithm was implemented; (4) elaboration of effective data structuring schemas and operations; and (5) presentation of results via a customized Web interface. Association Rules Mining-ARM on distributed patients' clinical encounters is our main focus. Given a set of transactions *D* (i.e., a set of items representing clinical observations), the ARM problem is to discover the associations that exhibit an adequate level of 'interestingness' (measured with frequency-based metrics, such as the support and the confidence of an association). The designed and implemented AprioriXML ARM algorithm operates exclusively on top of XML documents.

*Results:* The conducted experiments focus on specific queries, posted over the distributed and interconnected clinical information systems in the Crete region. For example, one of the queries was: 'find interesting associations between biochemical lab findings for hypertension diagnosed patients'. For this inquiry one of the discovered association rules is: CHOLESTEROL/TRIGLYCERIDE and ALALINE\_AMINO\_TRANFERACE\_SGPT ASPARATE\_AMINO\_TRANFERASE\_SGOT /support 48%, confidence 95.2%.

*Discussion:* We present a methodology, its respective architectural setting and operational framework, for knowledge discovery from distributed and heterogeneous medical databases. The discovered (interesting) associations between the respective clinical items, present potential health indicators. Furthermore, keeping track of the discovered associations, and continuously evaluating their trends over the increasing regional patients' population (during specified time periods), potential interesting health indicators could be easily identified and explored. In this respect, our work is a step towards the automation of Internet-based epidemiological studies.

*Keywords:* Integrated Advanced Information Management Systems, Internet, Artificial Intelligence, Epidemiological Methods, Statistics.

### **Internet-Based Health Information System for Indonesian Decentralised Health Services**

A. Fuad, L. Trisnantoro, J. Jeugmans

*School of Medicine, Gadjah Mada University Yogyakarta, Jl Farmako Sekip, Yogyakarta, Indonesia 55284*

*Introduction:* Indonesian health sector is currently facing a considerable challenge. Affected by the Law of Regional Autonomy (Law 22/1999) and Law on Fiscal Balance (Law 25/1999), health care decentralization must be implemented by 2001. The objective of decentralization is to better answer local needs. So that, based on the needs identified locally, local governments will be better able to develop an investment program for health/family planning services appropriately. However, transferring a number of central authorities to the local governments at the district level is impacting coordination and communication problem, which consequently affecting the process and output of the decentralization. This problem is undoubtedly critical, considering that there are more than 300 districts are scattered around Indonesia. Therefore, it is imperative to utilize an Internet-based health information network to facilitate communications and information sharing among various actors concerned with health sector decentralization.

*Materials and methods:* Internet-based communication systems are proposed to solve the problem. This system is intended to assist localities in planning activities and overcoming arising problems in implementation of health care decentralization through consultations with experts from leading universities and other research-consulting firms. This form of consultations will be facilitated by the discussion forums, which may be accessed directly from this web site or through mailing list.

*Results:* A dedicated web site for Indonesian health sector decentralization (<http://www.desentralisasi-kesehatan.net>) and the related mailing list has been developed. Since the development on July 31, 2000 in its first month there are 79 members and 71 messages posted into the mailing list.

*Discussion:* The big challenge for this initiative is how could the systems become wider so that it will involve all 27 provinces of Indonesia (with more than 300 districts). Practically, until currently the website only contains information and decentralization progress from 7 provinces. However, this aspiration is limited by the fact that not all the districts have Internet access and IT facilities as well as human resources concerns.

*Keywords:* Portal site, public health informatics, health care decentralization.

### **Building web-enabled Drug Information Centers with Traditional Word Processors, Markup Language, Telematics Standards, and Controlled Thesauri**

R.H. Vander Stichele <sup>a</sup>, J. Van Campen <sup>b</sup>, A. Attipoe <sup>c</sup>, G. Thienpont <sup>d</sup>

<sup>a</sup> *Heymans Institute of Pharmacology, Ghent University, Belgium,* <sup>b</sup> *Scientific Association of Flemish General Practitioners, Antwerp, Belgium,* <sup>c</sup> *Associated Consultants and Software Engineers, Brussels, Belgium,* <sup>d</sup> *Research in Advanced Medical Informatics and Telematics, Ghent, Belgium*

*Introduction:* Providing independent information on medicines to physicians and pharmacists has been a traditional task of Drug Information Centers (DICs). Most European countries have one semi-official center, often closely linked to official pharmacovigilance activities and subsidised by the regulatory authorities. These centers now face a double challenge. Firstly, they need to embrace the new communication technologies, to diversify the information channels, connecting them to physicians and pharmacists. Their traditional publications need to be edited not only for print, but also for electronic publishing and distribution through the World Wide Web. This transition is not merely a transcription of existing information, but should encompass new applications and added-value. Secondly, official DICs are now called upon not only to serve the community of health professionals but also the consumers, the citizens, the patients. This presentation will describe the technical solutions implemented by the Belgian Drug Information Centre.

*Materials and methods:* The Belgian Centre for Pharmacotherapeutic information (BCFI) traditionally publishes four types of publications: an annually list of drugs on the market (with full practical prescribing information and short critical comments on the therapeutic value of the different medicines), a monthly free circulation continuing education journal (also used as distribution system for the yellow cards for adverse drug reaction reporting), a collection of therapeutic sheets with the key pharmacological data of hundreds of therapeutic substances, and finally a collection of more than 30 monographs on selected therapeutic fields, discussing the relative value of the drugs available in that field. From the start, preference was given to an information processing system based on structured text and markup language (Standardized Generalized Markup Language – SGML), rather than on the classical database paradigm. With the help of an consultant in information architecture (ACSE, Belgium), a thorough structural analysis of these documents was made, resulting in the creation of 4 different Document Type Definitions, one for the annual list, one for the journal, one for the information sheets and one for the monographs. Consistency in the labeling of elements, common to the four types of documents was enforced. For the elements needed to describe the medicinal products and medicinal product packages, we used the model of representation of the new European Standard for Medicinal Product Identification (ENV12610), issued by the European Committee of Standardization (CEN/TC251).

*Results:* Starting in December 1998, a project team of physicians and pharmacists (2FTE) cooperated during 8 months with the information architects and the BCFI-editors to produce 4 Document Type Definitions (DTDs), one for each publication type. The DTDs were implemented in WordPerfect 6.0 (SGML-edition) on decentralized personal computers, connected by E-mail. The editors were trained in 3 sessions of 4 hours in this editing system. Legacy conversion of the previous edition of the National Drug Annual list was performed in a semi-automated way. The resulting SGML file was edited by the trained editorialists and updated for the new edition of the annual list. Proof reading copies were produced on PC-printers with a WordPerfect graphic style sheet. A new edition of the Annual Drug List (in Dutch and in French) was printed from the SGML-file, without any manual correction in the photo composition system. In February 2000, a bilingual web site was opened, hosting an updated version of the drug list, with monthly updates, closely following market changes. Updates on the web are created by programmed conversion of the SGML files into HTML (the language of the World Wide Web). From the updated SGML-files, each month a database of medicinal product packages (registered and present on the Belgian market) is produced for further distribution into hospital information systems and computer assisted prescribing systems. The database includes a validated link between the unique identifier of each medicinal product (as used in the national distribution systems) on the one hand, and the international ATC (Anatomical Therapeutic Chemical) classification. The database is also the cornerstone of the Belgian drug utilization monitoring system, which tracks all prescribed, dispensed and reimbursed medicines. The annual revision of the new printed edition of the Annual Drug List, to be shipped in October 2000, proved to be a less cumbersome process as in the preceding years, as many technical updates of the SGML-file were made on a monthly basis. Legacy conversion of 5 volumes (1996–2000) of the monthly journal *Folia Pharmacotherapeutica* will be finished and posted on the web by the end of 2000.

*Discussion:* This approach to technical innovation in the production process of a national Drug Information Center allowed the editors to continue their job in the familiar framework of traditional text processing. It was not a steep learning curve to master the SGML extensions. Work load for routine procedures remained unchanged, despite additional effort to comply with rigorous structural demands for new functions. There were productivity gains in the correction cycle of blueprints, in multilingual collation activities and in transfer of versions between editorial sites. The error rate dropped due to reduction of manual remanipulation of text. Internal consistency of text and lay-out was enhanced by automated validation procedures. Editors felt that they could now focus on content rather than on presentation, despite the increased diversification of output media. Because European standards for medicinal product identification were adopted, the effort of updating the national drug list is now instrumental to a collaborative effort to create and maintain a European database of medicines on the national markets. The real challenge of this project lies ahead. In the near future, the different publications of Drug Information Center will be available for publication on the web. It will be possible to integrate them into one tightly interconnected information system for health professionals. To make this integration (and its updating) ergonomically possible, structural elements must be identified to facilitate automated linking procedures. These automated links will be new technologies, such as XML-server technology, XLINK and Xpointer. It will also necessitate the careful elaboration of a proper thesaurus, of linking to a formal medical ontology, of linking to existing thesauri such as MeSH (Medical Subject Headings) and MedDRA (Medical Dictionary for Regulatory Activities Terminology). To facilitate interaction with the site and other sources of evidence-based medicine, natural language processing will be implemented in the query tools. An interface with the web-based multilingual medical glossary of technical and popular medical terms will be created, to facilitate access for lay people, consumers, citizens and patients.



*Keywords:* Drug Information Services, Vocabulary-controlled, Natural language processing, Reference standards.

### **A Software Agent for Systemic Retrieval of Medical Information from the Internet**

P.A. Kokkinidis, L.P. Gatsoris, A.E. Germenis

*The Athens Medical Society, 23 Meandrou str., 11528 Athens, Greece*

*Introduction:* Facilitating users in finding new information in the Web remains a challenging goal not only due to the information overload but even more, due to the various ways of its construction and presentation. To this aim we developed a software agent able to monitor and analyze user-specified Web sites and to present their contents in uniform structure.

*Materials and methods:* The agent is working under MS Windows environment and requires an Internet connection (permanent or dial-up). It is using a local database containing: (a) Descriptive and classification data of Web pages, (b) string patterns based on regular expressions and HTML tags appearing in these pages, (c) Web page specific monitoring and updating plan. Based on these data, the agent periodically or on demand checks the websites and stores their contents locally. Data are presented in a uniform manner (title, authors, content description, abstract URL, full-text URL, etc., where applicable) searchable and optionally filtered by the user.

*Results:* The agent is distributed as freeware. At the time an individual user adds or updates Web pages to the local database, the agent automatically updates a central database installed in our Web-server. Central database contents can be queried and retrieved by the users.

*Discussion:* Sharing of users' collections will result in the formation of a continuously expanding database of resources. The main drawback of the agent logic that is the failure of analyzing and parsing process in case the Web page(s) design will change. Updating of the central database by a large number of users will help in anticipating this problem. Due to the above characteristics and functions, our agent is a valuable tool for systemic reviews of Internet information.

*Keywords:* Automatic Data Processing, Bibliographic Databases, Online Systems, Internet, Information Retrieval.