ITALIAN JOURNAL OF PUBLIC HEALTH

Spider: managing clinical data of cancer patients treated through a multidisciplinary approach by a palm based system

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Abstract

Background: The complexity of modern oncology, based on multi-disciplinary management of cancer patients, results in critical amounts of data, leading to problems in managing and sharing information.
Methods: Spider is a multi-user system, based on integrated palm technology, created to facilitate data recording, managing and sharing, through Intra-Internet connection. By palms or PCs, data are collected directly at the place where information is generated. Every health professional can edit, modify and display all of the patient's data according to his/her operational level. A powerful engine enables Spider's users to create series of cancer patients' appointments linked to one another by specified time intervals and save them as "Protocols". Applying a protocol to the patient, the system schedules a wave of appointments and alerts keeping the correlation with time intervals previously specified by specialists.
XML technology is integrated with traditional RDBMS technology to build the Electronic Patient File (EPF) updated during each patient's admission or consultation, including any new diagnostic/therapeutic events and collective decisions. The system automatically produces all clinical documents routinely in use (discharge letters, exams' requests, etc.).
Results: Spider's different archives include 4387 patients (Prostate, n=849; Lung, n=1596; Rectum, n=1541; Head & Neck, n=291; Cervix, n=110). The EPF includes specific modules: staging, surgery, chemotherapy, hormonotherapy, radiotherapy, toxicity, pathology, follow-up and clinical summary. Spider Hospitalization displays the ward map and important details of patients occupying each single bed.
Conclusions: Spider makes data capture easier and accurate. The availability of large amounts of information accelerates outcome analysis and improves cancer research.

Key words: health information technology, electronic medical record, data sharing, personal digital assistant, multi-disciplinary cancer care

Introduction

"At the beginning of the 21st century, while we are used to having detailed records on buildings, cars, machines, household devices, etc., health maintenance records are often very inadequate'. Furthermore, the 2002 Electronic Health Records Status Report points out that it is common to have only sparse provider-specific, often specialty-specific, medical notes, (sometimes scribbled on paper and partly illegible), and even these are not coordinated or complete [1]. In many cases, health professionals have to act blindly without any background data on the patient, tests have to be repeated and other practitioners often do not know an individual's previously identified conditions and allergies.

Besides, the modern medicine is more and more characterized by chronic illnesses and ultra-specialist management of care based on the shared care paradigm [2].

The cancer care of patients is a typical shared care example. Only a multimodality approach makes possible cancer treatment; thus, the modern oncology is based on a multidisciplinary management of cancer patient both in the diagnostic phase as well as in therapeutic or

follow-up ones. Consequently, the process of cancer care involves numerous phases as well as various specialists or professionals, with different training backgrounds and organizational cultures, operating sequentially or simultaneously. The collaboration and consequently the communication of information are mainly asynchronous.

The development of technology covers all aspect of modern oncology, from various points of view, putting at oncologists' disposal a growing amount of data and, at the same time, making themselves indispensable to clinicians for correct cancer patient's management.

Therefore, in different ways, the complexity of the modern cancer patient's care determines critical masses of various data (laboratory, radiological information, multidimensional scores, etc., linked to organizational aspects of protocols), causing complex problems in collecting, managing and sharing information. The multiple places and times in which information is generated call for particular attention to new modalities of data recording, archiving and interchanging by the various specialists involved in clinical practice and studies.

In parallel with these changes, the computer has become integral to health care delivery, driven in part by accelerated development of digital applications and communication technologies over the last two decades. Progress in hardware development, software applications and interfaces has resulted in multimedia systems [3]. Traditional medical technology is actually pursuing more and more sophisticated and powerful perfusion MRI, Four-Dimensional Computed Tomography and Linear Accelerator providing IGRT. At the same time, Health Information Technology (HIT) focuses on the development of applications such as hospital information systems (for administration and access to, for example, admissions or laboratory results), Electronic Health Records (EHRs), Computerized Physicians Order Entry (CPOE) systems, Clinical Decision Support Systems (CDSS), and large networked computer systems.

However early accurate analysis of cancer treatment trials is curbed by a failed or deficient computer-stored data system related to costs in terms of time as well as the human and material resources needed, linked to the lack of systematic information capture or inconsistencies in data.

Inside this complex context, our Department of Radiation Oncology developed Spider (System for Patient Individual Data Entry and Recording), a multi-user system based on integrated palm technology, to facilitate data recording, archiving, managing and sharing, through Intra-Internet connection. The main objective of Spider's Net is aiding researchers in their data collection; the final goal is verifying the effectiveness of therapies, making data recording easy and reliable, management aspects simpler, especially those connected with diagnostic and therapeutic protocols of cancer patients.

Methods

Spider's Net is a multi-user system, which is accessible through local (intranet) PC's, remote (internet) workstations or palm computers, both in a disconnected mode and online (wi-fi).

Several actors play different roles in the system and different operational levels, according to the role they play in the patient's management. Flexibility both in the input and output domains is a key feature of Spider's Net, along with the production of an EPF (Electronic Patient File) which can be extended by other operators, totally unbound, on a project level, from contingencies determined, directly or indirectly, by data collection or query procedures. Data structures, their qualification, data relations, are stored in a dictionary that allows most common RDBMS (Relational Database Management System) to collect huge amounts of data, with a great degree of efficiency in all data management operations. XML technology is implemented side-by-side and integrated with traditional RDBMS technology, resulting in a product that offers the best of both worlds, with an obvious advantage in data exchange between different systems, and, what is more important, a natural separation between data contents and presentation (Figure 1).

By using XML, Spider's Net Users build and manage the administrative workflow of any diagnostic-therapeutic protocol using electronic forms, while the production of reports and information exchange are greatly simplified or, better still, automated.

Patient's identification

By SPIDER's integration with the Hospital Information System (HIS), the patient's personal data can be captured directly from it without the need of new entry. The same integration automatically makes health professionals both plan next patient's admissions and have the given performances' accounting (Figure2).

The ID photo as well as other types of photos documenting a certain toxicity grade or any macroscopic disease (etc…) of cancer patients can be associated to his/her own chart. Any paper

Figure 1. Spider's Net matches RDBMS technology's advantages with XML technology's benefits.

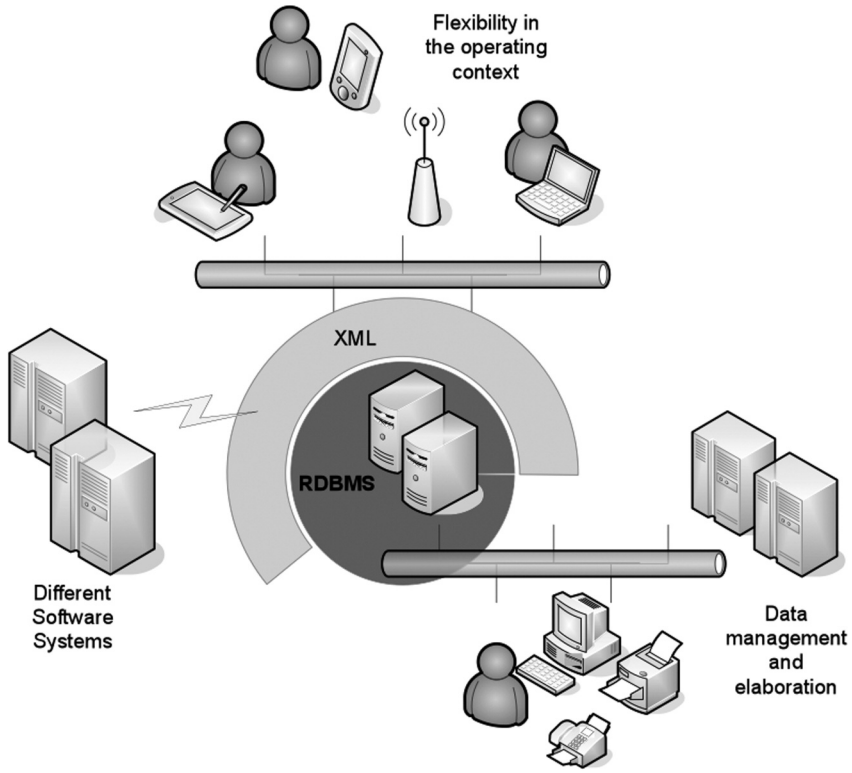
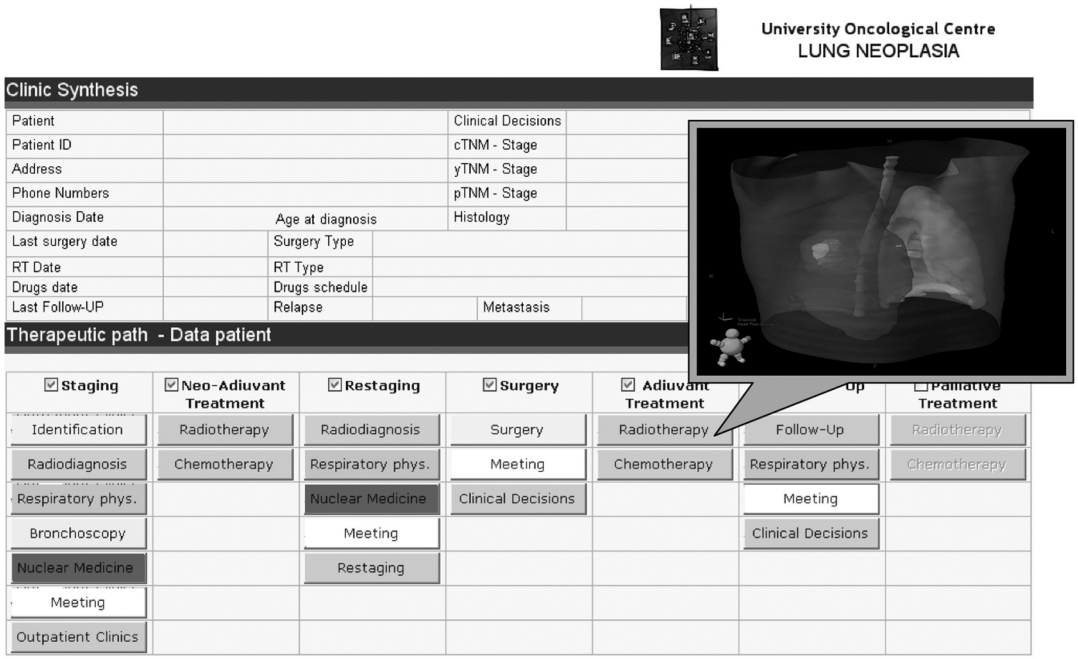


Figure 2. Spider's Net monitors the patient through his/her therapeutic pathway.



based form (for example the one expected into different Departments' Quality Assurance Manuals) for gaining informed consent for personal data and images management can be automatically printed.

Appointments and procedures

Completely and easily, the user can define procedures relevant inside his/her department.

The custom enters details of the activity, the relationship to another procedure, if applicable, minimum/specific/maximum time between

related activities, and eventually the staff/location assigned.

A powerful engine enables Spider's users to create series of cancer patients' appointments linked one another by specified time intervals and save them as "Protocols". Consequently, when one of the designed protocols is applied to a patient, the system schedules a wave of appointments and alerts keeping the correlation with time intervals previously specified by specialists. If an unexpected toxicity or unforeseen events cause a shift of one of planned appointments, successive scheduled dates are modified to respect the specified time intervals.

You can display the patient's appointments on a calendar; you can make and print reports of the patient's schedule, of any appointments retrieved for weeks, for departments (to plan admission), for kinds of events, for surgical groups, etc…

Simultaneously Spider's Net makes the user create and manage waiting lists planning resources, appointments, procedures by a "shared agenda". Spider can automatically fill, using existing data, and directly print electronic or paper forms that the health professional needs for orders, drugs' preparation, radiological imaging requesting. Spider can ensure complete integration with HIS admissions and appointments' waiting lists.

Specialty Meeting

Multidisciplinary meetings, involving each specialist taking part in the therapeutic pathway of the cancer patient (surgeons, radiologists, radiotherapists, pathologists etc.), can be easily managed by Spider for the more common tumour sites: it can provide the agenda and the list of cases to be discussed (with the possibility to enclose radiological images in electronic format); it allows to send e-mail invitations to all participants. The final drafting of meeting minutes and collective therapeutic decisions can be automatically stored.

EPF (Electronic Patient File): a "meta-record"

The challenge of asynchronous communication among different care units, dealing with the same cancer patient during his/her complex route - since the diagnosis until the follow-up after the multi-modal treatment - is faced by the constitution of the EPF.

Information collected at different places and moments, during different phases of a clinical protocol, are automatically included in the EPF using categories taken from the dictionary, configured and maintained by operators themselves.

The EPF gathers data from different forms – paper based or electronic forms - representing the kind of information that each specialist needs and produces during the patient's care thus avoiding unnecessary duplications or distortions. This is realized through the dictionary, the XML Editor and data relations previously settled by clinicians.

Data can be grouped and displayed by different modules. The user can completely customize each module and its layout (screen views, reports and printable forms). Thus, a module for Ward setting or for Ambulatory Follow-up Care setting as well as for First Consultation setting, etc… can be easily designed by the user (with system's administrator rights).

By palms, PC workstations and paper forms - exact copies of electronic forms - data are collected directly at the place where the information is generated: at the doctor's office, at the ward, at the operating room, at the pathologist's office and radiologist's rooms. Every health professional can have prompt availability and modifying capability of the entire patient data, according to his/her own role and operational level (Figure 3).

The Electronic Patient File is also updating during each patient's admission, including every new "diagnostic events" (grouped by cancer related relevance and unspecific ones), some chosen, for example, TC or PET scans (as well as other kinds of imaging scans), therapeutic events and collective decisions. The report of the admission is created automatically and can be printed saving a lot of time with increased efficiency.

The system was designed to automatically produce all the clinical documents which are routinely in use in our hospital (history, visit, diary, discharge letter, etc.), and simultaneously enrich the EPF.

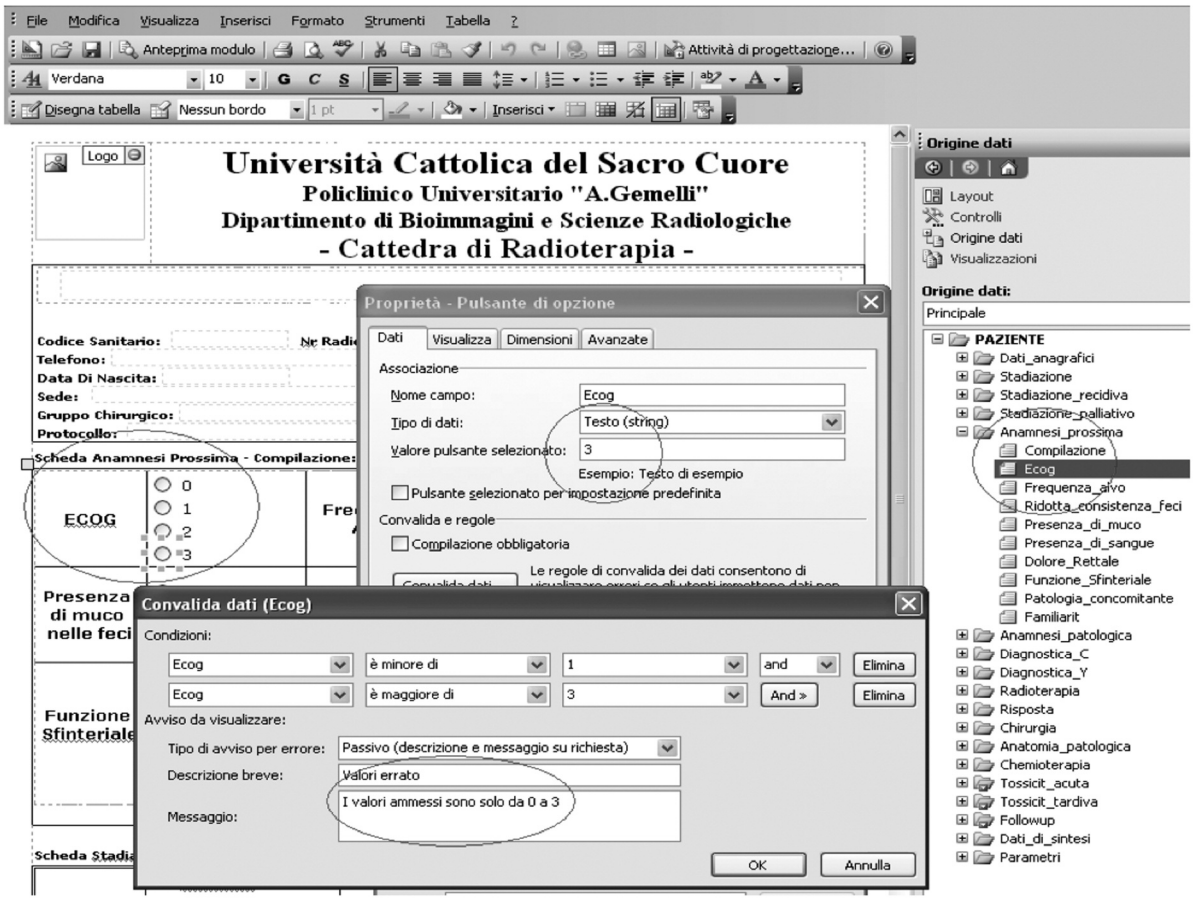
Results

Since 1979, our Radiotherapy Department started to pay attention at new modalities of data management based on PC utilization to face the complexity, the needs and the costs of increasingly multimodal cancer care.

Aiming at this goal, systems providing computer information storage has been implemented to ensure administrative and clinical data management for organizational purposes (UNICARO [4] - FLORENCE [5] – START [6]) as well as for research reasons (MERCURIO [7] – ONCONET [8]).

Since 2000, the radiation oncologists of our division implemented the idea of a system capable

Figure 3. By palms or PC workstations or paper forms, exact copies of electronic forms, data are collected directly at the place where information is generated. Each health professional can have the prompt availability and modifying capability of the whole patient data according to his/her own role and operational level.



of input and output flexibility, extreme connectivity among different specialists, everyone involved with the same cancer patient's care: thus, Spider's Net Rectal Cancer Release 1 occurred.

2001 gave birth to Spider's Net Release 2, for the management of more than 1000 patients with rectal cancer. It included palm connection and internet data synchronization [9].

In 2004, Spider Cervix [10] Rel.1 has been realized to optimize the care of patients with cervical cancer undergoing a multimodal treatment.

In 2005, the Xml Technology use and Spider's link with HIS of Policlinico A. Gemelli were provided with the realization of Spider Prostate [11] Rel. 1 and Spider Cervix Rel. 2 totally integrated with the Hospital Information System (HIS).

In 2006, Spider was implemented with the Xml Editor and the Dictionary utilities to realize other Spider Archives without requiring professional technical support.

Inside Spider's Net Rel. 4 (2007), data are stored at the central server of the HIS that ensure data back up and protection. The database has been completely defined by various specialized physicians (the radiotherapists, the surgeons, the radiologists and the pathologists) involved in the project, which is the multimodal management of cancer patients. It was made without the intervention of the system planner; moreover, using **.xml electronic data processing software (example: Microsoft InfoPath), the graphic interface has been directly drawn by the operator to meet his/her liking. Thanks to a sophisticated system of passwords and authorizations, each single piece of data can be safely shared among different specialists as well as kept reserved.

Spider-Lung and Spider-Head & Neck are active from 2007; Spider-Breast is currently being created in collaboration with specialists already operating inside the Breast Cancer Unit of our Institution.

Patients currently stored in the various Spider

Archives are the following:

- Spider's Net – Rectum includes 1541 patients and different modules: history, staging (imaging, digital rectal examination, histology, nuclear medicine, endoscopy), multidisciplinary meeting, neoadjuvant treatment (chemo-radiation, toxicity), restaging, surgery, IORT, pathology, adjuvant treatments, follow-up, salvage/palliative treatments;
- Spider's Net – Cervix includes 110 patients and different modules: history, staging (imaging, histology), tumour board decision, surgery, radiotherapy, chemotherapy, pathology, restaging, follow-up, salvage/palliative treatments.
- Spider's Net – Prostate includes 849 patients and different modules: history, staging, surgery, hormonotherapy, therapeutic protocol, radiotherapy (technique, fractionation, dose, volumes and toxicity), follow-up and clinical summary;
- Spider's Net – Lung includes 1596 patients and different modules: history, staging (imaging, respiratory physiopathology, nuclear medicine and histology), tumour board, neoadjuvant treatments (chemotherapy and/or radiotherapy, toxicity), restaging, surgery, pathology, adjuvant treatments, follow-up and salvage/palliative treatments;
- Spider's Net - Head & Neck includes 291 patients and different modules: history, staging (imaging, histology, nuclear medicine, otolaryngologist examination and endoscopy), tumour board decision, surgery, radiotherapy, chemotherapy, pathology, restaging, adjuvant treatment, follow-up, salvage/palliative treatments

The dictionary related to the above type of cancer's archive has been defined during multidisciplinary meetings. Several multidisciplinary teams, meeting usually weekly, have identified together all data needed to be archived, the storage mode, and the forms useful in the clinical practice. This modality has avoided data duplications and distortions, as well as the uniformity of outcomes' storage and analysis.

Moreover, the doctors and programmers of our team, have studied the flow of clinical data that is daily generated in a modern cancer centre. This resulted in the creation of a further repository, transverse to each individual pathology database. Since 2006, by Spider Hospitalization Module, the health professional can display the map (not only the count) of the total number of beds resourced and available for use on a WARD, their actual versus planned utilizations, as well as important details related to patients occupying each single bed.

The window of DAILY WARD MAP ensure a "Virtual Tour": the system allows physicians to scroll down beds moving from one patient's need or assessment to another one's, thus having a summary of evidence of recent events, communications and any other relevant information regarding each patient. A link with nurses' diary, patient's notes and exams is also available.

Physicians can schedule admissions referring to the "shared agenda", respecting the timing and types of procedures as previously defined, by assigning a specific protocol to the patient. Notes related to each admission can be added; they can be displayed when the DAILY WARD LISTING is prepared and linked to the ward beds' map.

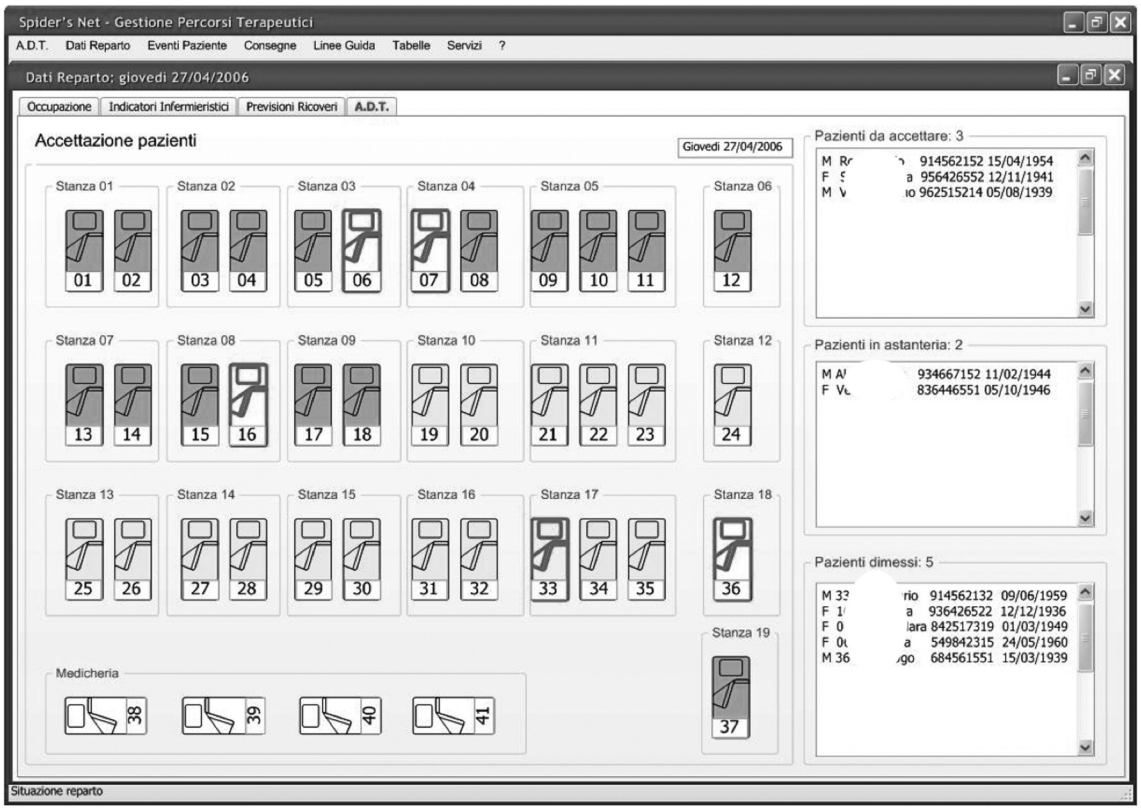
In fact, consulting the DAILY WARD MAP (Figure 4), promptly displaying the gender of admitted patients to size groups and fill available rooms, the user can easily view a list of some important details related to every single bed:

- the name and the diagnosis referring to the patient occupying each single bed
- the therapeutic protocol defined for the patient or the reasons justifying his/her admission
- the patient's main vital signs and symptoms
- the specification of the patient's nutritional status and/or any dietetic regimen has been observed
- the planned approximate duration of each hospitalization with the date of possible discharge, the patients' performance status (for example fully active versus confined to bed or chair) in order to plan admissions considering the predictable needs of assistance and staff availability.

E-mail system

Spider's Net implements an e-mail system, which offers to operators, including those operating from a palm terminal, the possibility of linking messages to patients or activities, making up a "to do list", or issuing warnings, depending on the priority level of the message, to be stored in the EPF. For example, an email alert is sent to the surgeon to confirm or postpone the planned operation date of a patient who has just finished a preoperative radio-chemotherapy treatment. An email message can be sent to organize a multidisciplinary meeting. The collective decisions are saved into the "electronic patient file".

Figure 4. Spider Hospitalization Module, the ward map.



Queries

Powerful and fast data tracking is one of Spider's key capabilities: the system enables information workers to perform data-tracking tasks that, otherwise, would require the time and expertise of professional programmers and database administrators. The various specialists can build the layout of retrieved data reports as well as the printable form listing the group of patients sharing the queried information, according to their own needs and purposes (clinical research, organizational aims, meeting-oriented reports, utilization analysis, etc…).

Health professionals inside their area of interest define a set of essential data; Spider can automatically create a clinical summary (Epicrisi), track down missing data and display or print the report of "information debt". The users, for example, can easily find out lists of patients missing the last scheduled follow up consultation or requiring some specific interventions.

Certifying capability

Spider's NET links true relational database storage with the "certifying capability": some clinicians with supervisor ability and tasks, within the different specialists' areas, are enabled to "lock" information previously validated by collective decision. Consequently, data yet used in writing papers reporting trial outcomes, are made "fixed" so that no mistakes in manipulating information can invalidate the results' credibility at any time.

Importing/Exporting capability

Data stored by Spider, thanks to XML technology, can be retrieved as, for example, excel data to be used by various software packages for statistical analysis. At the same time, quickly the system can import excel data, photos and diagrams.

Security

Stored information is encrypted in order to meet the need for data security. You can log on the system only by using your own login and password. Encrypted data is considered irretrievable without the keys; this it protects the data from unauthorized use and Spider's Net from violating the Italian privacy policy. Furthermore, different security attributes for users exist. The system administrator has a choice of various security levels to assign to each user in relation to his/her own role.

Personal digital assistant

Palm computers can display, query and manipulate patients' information by encrypted connection exchanging encoded data. Email messages and notes can be consulted by PDAs. Physicians can determine patients' admissions and discharges also by palms.

Actually, Spider schedules appointments for staging exams, consultations, admissions for chemotherapy (etc…) as well as plans tests or examinations during follow-up.

All the information recorded during these procedures are shared and updated on-line by all specialists, using palms and wireless technology. Consequently, these data are available in real time to the single physician for clinical and research purposes (by statistical software' analysis). Besides, Spider interacts with patients' central hospital database to acquire all information about their hospitalizations (registry data, laboratory tests data, radiological imaging, descriptions of the surgical interventions and pathological anatomy reports).

Spider calculates automatically the months of global survival, disease free survival, free biochemical or local recurrence survival and identifies patients lost to follow-up. Information interchange among various physicians and nurses - with the purpose of optimizing the communication and, therefore, the integrated assistance to the cancer patient at different places and phases inside the hospital – is being facilitating by the e-mail utility (enjoyable also from palms). The optimization of data entry and recording contributes to the improvement of care and outcomes. The clinical summary created automatically by Spider results extremely useful both for the single user and for the weekly multidisciplinary meeting. Currently, the advanced release of the system allows the stored data exporting and the automatic compilation of reports and forms both for administrative and clinical purposes. Vice versa, the daily input of the Spider Hospitalization' data, through the utilizations of its multiple clinical records, the single pathology database and the EPF will be updated.

Statistical analysis of cancer data recorded by Spider's Net has currently resulted in twenty-two articles being written and submitted to international (eleven) and national (eleven) specialized periodicals respectively.

Discussion

Improving care for chronically ill patients requires a longitudinal, team-based approach [2]. Also related to the dramatic progress in medicine during the last decades and consequently higher life expectancy, cancer patients, for various reasons, belong to this complex category of patients, and it has been observed that no decisions on diagnostic, therapeutic or other procedures can be made without appropriate access to relevant data, with fatal consequences for patients [12].

In the literature there is a multitude of papers describing the past, present and future of Heath Information Systems [12], their promises [13] and obstacles [14-15], attained targets [2,16-17] and the current stalemates [14]. Some systematic reviews of chronic disease management and Health Information Technology (HIT) have provided insight but no clear answer about how to create and successfully implement comprehensive systems positively influencing health care for this complex kind of patients [2]. During the last few years, HIT has produced many different solutions for an integrated approach to information management, finding its top technological achievement with the introduction of ERP (Enterprise Resource Planning) systems.

Despite most published literature, issuing the need of international guidelines and efforts to capitalize on Information and Communication Technology (ITC) supplying Health Care [12], in many IT firms' opinion, the medical ERP system is, still today, not directly tied to a global view of project management. ITC seems to pay most attention at a small part of it: administrative and financial transactions rather than on delivering clinical care [18]. Unfortunately, this widespread view is easily confirmed in those firms' offer of "ready to go" systems. Looking at the Italian experience, it appears to be a common behaviour.

With the introduction of EPF (Electronic Patient File) all integration issues are solved and superseded by a complete horizontal management of all functions involved in medical and social structures. The EPF system is not monolithical; on the contrary, it is the only way to achieve a true integration with existing modules by a seamless management of patient data and processes.

This reflects the well known need of putting the patient and his/her data at the centre of all processes involved in medical assistance [12], while, at the same time, keeping high the attention level regarding all security and privacy issues.

The "patient file" is a new source of information, gathered from different actors, that implements the "data on demand" vision. This means that

information of different kinds (social, medical, administrative…) is made available when, where and in the way you need it, in full compliance with all regulations regarding security and privacy.

Spider's Electronic Patient Record is intended to meet all of the previous issues and benefits.

The relevance of systematically processing data, information and knowledge for the quality and efficiency of health care is obvious [12] but hard to show. Adapting new information systems to health care has proven difficult and rates of use have been limited [19-21].

Hillestad et al. [22-23] examined the potential health and financial benefits of HIT: widespread adoption of electronic medical record (EMR) systems, its implementation and networking could potentially save more than $81 billion annually, by improving prevention and management of chronic disease, reducing morbidity and mortality.

In their systematic review, Chaudhry et al. demonstrated three major benefits of health information technologies in improving quality and efficiency [21]: increased adherence to guideline-based care, enhanced surveillance and monitoring and decreased medication errors.

De Keizer and Ammenwerth reviewed HIT studies for content and outcomes.They found that most evaluation studies focus on "appropriateness of care" (80% positive effect); considering the "efficiency" and "costs of care" they showed mixed effects and only 15% of studies was focused on "outcomes of care" revealing 66% positive effect [24-25].

However, gaining these benefits requires broad adoption, effective implementation, and associated changes in health care processes and structures [22-23].

Spider's main purpose and result have been the easier information storage, tracking and displaying. Spider's Net has enabled specialists involved in the project to systematize data entry, to check the "information debt" any time as well as during specified collective meeting or fixed appointments. Collecting and analyzing automatically updated data of cancer patients referring to our Departments become consequently faster and more precise, also accelerating routine information workflow. Missing data as well as data entry duplications have been reduced thanks to the better information control and management.

Electronic Data Communication is one of main challenges in step with the EPF's building. In order to meet the increasing need for a better data communication, many obstacles must be overcome, such as software heterogeneity, lack of standardization, especially when the communication between care units are involved. Under this point of view, CDA (Clinic Document Architecture), under the Health Level 7 (HL standard, is a new and quite promising instrument for the exchange of any clinical document). Since the XML standard (eXtensible Markup Language) makes data transmission between different computer systems easier, in 2000 HL7 released a standard conceived for the implementation of clinical documents using XML: XML-based HL7 clinical document architecture (CDA). This approach is a standardized system for information exchange, on which a patient archive can be built, overcoming the obstacle represented by the differences existing among various hardware and software systems.

The other main challenge is the development of software that can easily be modified and transferred from one institution to another to fit specific and local needs [26-27]. Spider's Net uses XML technology matched with traditional RDBMS to ensure that new archives can be created by health professionals without requiring professional technical support and to provide electronic data communication. Spider's Net has been analyzed and designed with a patient-centred approach in mind and not conceived as "single process on commission" base. The system is intended for being a flexible product with good integration capabilities opposing "niche solutions".

Regularly multidisciplinary meetings are the minimum requirement to develop a new, single-pathology Spider Archive. At least approximately one year, involving the whole team is required to reach an agreement regarding the information to be recorded, users who can access data, their operational levels and permissions, and the types of forms useful to multidisciplinary meetings.

The Italian practice, involving health information technology and patients' care, focuses routinely on administrative data management and financial transactions. The majority of electronic patient records are conceived to face the single patient admission; they can include PDF files to display exams' reports attached, but they can't represent a longitudinal database.

In searching the literature, only a few Italian experiences relating to EMR's use are described:

- the realization of a prototype regional registry for diabetes mellitus based on data belonging to general practitioners and diabetes centres of the Umbria region already equipped with electronic medical records [28].
- the inclusion of various kind and format images

(CT, MRI, etc.) pertaining to the Intensive Care Unit patients (Emergency Department of the A. Gemelli Hospital in Rome) in the electronic patient record with benefits and avoiding the need for time-consuming searches through the hospital's paper-based archives [29].
- an integrated clinical-administrative DICOM-based HIS-RIS network, at a private orthopaedic hospital, connected to the radiological department PACS implemented through an internal web-server over a mixed wired-wireless network [30].
- the development and implementation of a RIS-PACS system to support the management of clinical data and radiological reports and images to create a filmless and paperless organisational model for the Radiology Units [31].
- the evaluation of benefits and applications of computers and multimedia systems in post-mortem examination practice [32].
- START, an advanced radiation therapy information system (RTIS) which connects direct information technology present in the devices with indirect information technology for clinical, administrative, information management integrated with the hospital information system [6].
- the description of a relational database in neurosurgery [33].

They represent early attempts at building EMR, but they have been conceived as a "single process", aiming to connect eventually images and clinical or administrative information for a single Care Unit, oriented to a single specialist user.

Spider's Net, on the contrary, is not a "departmental information system" focused on small functionally limited applications in special units of a hospital (for example at a neurosurgery, intensive care unit, radiotherapy and radiology or administration division). It aims at building of an integrated longitudinal patient electronic medical record to capture systematically outcomes data, to generate patient summary sheets and longitudinal displays of information as well as to perform data-tracking tasks and realize very customizable reports or excel files for statistical analysis purposes. Spider's Net meets the need of data exchange among several specialists avoiding information mismatch by the "shared data dictionary" and without data entry's duplications [34] ensuring reproducible analysis of results through the "certifying capability", the constant control of missing data, etc.

Despite the increasing discussion on evidence-based health informatics, the quality of published evaluation studies on IT interventions in health care is still insufficient in some aspects [35]. In the next future new guidelines and programs are needed, in order to measure, report, and reward performance of HIT.

Spider's future implementation with other generic clinical alerts (drug interactions, tools to make adjustments relating to aging patients, renal or liver failure conditions…), decision-support tools and wireless access to electronic medical records could enhance the system's impact on quality of care.

The need to focus on cancer informatics in order to accelerate multi-disciplinary research benefits has been recently been outlined by Reddington et al. [17,19]. He reported that whereas steady advances are being made in improving survival, it is increasingly clear that further progress depends significantly on coordinating research and on maximizing its impact by sharing and integrating the vast amounts of data being generated [17]. Spider's Net has been developed sharing the same need and purpose. Its impacts in organizational aspects of cancer care (faster workflow, scheduling the cancer patient's complex therapeutic path, e-mail alerts, notes, planner capability, discharge sheets automatically generated) makes data capture easier and accurate.

The ease of availability of large amounts of data accelerates outcome analysis and advances cancer research. A careful analysis of therapeutic results at various points of care can improve cancer care and maximize the impact of cancer research.

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