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NOVELTIES IN DERMATOLOGY

# Electronic Medical History: Experience in a Dermatology Department

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Abstract. Computerization, with a change from paper to electronic format, represents an alternative to traditional information management. This model offers advantages in legibility, uniformity, accessibility, and use of the data. However, it is not easy to apply this process to clinical practice as it requires a suitable network, continuous application development, an implementation strategy, and the cooperation of all staff involved. We have reviewed our experience in the development and introduction of electronic health records and their adaptation to a pioneer dermatology department in Spain. Since our hospital was opened 1998, the model used is that of a single, centralized electronic health record, with supplementary departmental attributes. The electronic health record is conceived as an interactive database designed around the patient, with a procedure-based structure, and that obviates the need for hardcopies (paper or films) in practically all situations; it must comply with legal requirements. The system is installed on central servers maintained by the information technology department. The potential is unlimited; particularly important possibilities include clinical guideline-directed care, remote connection for general practitioners, and online activity, stock, and quality management. With the aim of realizing this potential, a technological change was started in 2003, moving towards what was to become the chosen system in the Community of Madrid to cope with the workload arising from new hospitals.

Key words: electronic health records, information technology in medicine.

## HISTORIA CLÍNICA EN SOPORTE ELECTRÓNICO: EXPERIENCIA DE UN SERVICIO DE DERMATOLOGÍA

Resumen. La informatización consiste básicamente en una alternativa a la gestión clásica de la información, pasando del soporte en papel al electrónico. Este modelo aporta ventajas en la legibilidad, uniformidad, accesibilidad y explotación de los datos. Sin embargo, no es sencillo aplicar este proceso a la práctica clínica, pues requiere un adecuado soporte de equipos en red, el desarrollo continuo de las aplicaciones, una estrategia de implantación y la colaboración de todo el personal implicado. Revisamos nuestra experiencia en el desarrollo e implantación de una historia clínica (HC) en formato electrónico y su adaptación a un Servicio de Dermatología pionero en España. El modelo elegido en nuestro hospital desde su apertura en 1998 fue el de historia única centralizada electrónica de uso común (HCE) que se complementa con aplicaciones departamentales. La HCE se concibe como una base de datos relacional, centrada en el paciente y estructurada por procesos, que cumple los requisitos legales y permite prescindir del soporte físico (papel o placa) en la práctica totalidad de las situaciones. El sistema funciona en los servidores centrales bajo el mantenimiento del departamento de sistemas de información. Las potencialidades son ilimitadas, destacando: asistencia por guías de actuación clínica, conexión remota con Atención Primaria, gestión on-line de actividad, consumos y estándares de calidad. Buscando alcanzar estas potencialidades en 2003 se inició un cambio tecnológico hacia lo que después sería el sistema elegido en la Comunidad de Madrid para soportar el trabajo de los nuevos hospitales.

Palabras clave: historia clínica electrónica, tecnología de la información en medicina.

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## Introduction

Computerization, which involves a change from hard copy to electronic format, is an alternative to the traditional approach to managing information. This model offers

several advantages, and in the last 10 years, we have witnessed a veritable explosion in the use of computers, to the extent that they now affect almost every part of our daily life.[1] However, it is not easy to apply this process in clinical practice, and continuous development, an implementation strategy, and the cooperation of all the parties involved are essential. The electronic health record has probably had a greater effect on the daily work of health care professionals and providers of health care services than any other technological tool. Fundación Hospital Alcorcón (FHA) became a pioneer in the implementation of the electronic health record in a public hospital in Spain in 1998. We review our experience in the development, implementation, and subsequent updating of a health record system almost completely based on an electronic format.

## What Information Should Be Stored on an Electronic Health Record?

From the perspective of patient care, we should only store information that is necessary for clinical decision making. This includes information on the state of the art and that referring to the patient's clinical situation.[2] An electronic health record should also include the administrative data necessary for quality assurance, management, and the running of the health care institution.[3]

We are already accustomed to using electronic databases such as Up To Date, Medline, or the Cochrane Databases. Internet allows us to consult reference texts such as clinical practice guidelines and bibliographic references, and some centers have access to full-text electronic libraries (eg, the Laín Entralgo virtual library in the Autonomous Community of Madrid). However, it is taking some time for patient information to be transferred to this format. In most cases, we continue to store our comments, laboratory data, and test results in conventional health records with limited opportunity to retrieve the information and absolutely no possibility of analyzing the data stored. The problem is no longer one of obtaining information, but of selecting, storing, and accessing it efficiently.

## Why Store Information in an Electronic Format?

Several years' experience with hard copy health records has enabled us to develop them by creating different types of form with a structure organized according to the needs of each center. However, despite these efforts, the model has several important limitations (Table 1). Computerization of health records aims to make up for these deficiencies by providing the improvements set out in Table 2. Our description of the model we implemented and the experience gained from our work over the last few years allow us to provide a clear picture of these improvements.

**Table 1.** Limitations of a Hard Copy Medical History

| | |
|---|---|
| 1. | Illegibility. Handwriting is often difficult to read. |
| 2. | Inaccessibility. Transport from the central records office is slow and expensive. It is impossible to consult simultaneously on the ward and in radiology. |
| 3. | Lack of unity and fragmentation. Partial "peripheral" records with incomplete patient information. Sometimes these are not available to everyone. |
| 4. | Lack of structure. There is usually no pre-established order, and if there is one, it is difficult to maintain because it is time consuming and staff who are directly responsible for this task are lacking. |
| 5. | Rigidity. Once a design has been established, it cannot be modified by changing the order of the data already entered. |
| 6. | Lack of uniformity. Information is recorded differently by different specialists. |
| 7. | Legal implications. It is difficult to ensure this "legal" document cannot be altered. |

**Table 2.** Solutions Provided by Electronic Health Records

| | |
|---|---|
| 1. | Legibility. The information can always be understood. |
| 2. | Instant access, at any time, from any point, and by several users simultaneously. |
| 3. | Complete information and unity. All available information on a patient is located in the different applications and is accessed by a single index (patient record number). |
| 4. | Order. An automatic order is maintained. This can be adapted to each user. Its structure or presentation can subsequently be changed, and all data can be retrieved. |
| 5. | Organization. Interconnection with specific applications maintains organization of the information without loss of accessibility. |
| 6. | Legal implications. Recording of information in such a way that it cannot subsequently be altered nurtures confidence in the system. |
| 7. | Potential. The system enables clinical information to be used, provides new help functions for the clinician (eg, warnings), and favors the use of clinical practice guidelines. |

### How to Store Information Electronically? Central and Departmental Health Records

The organizational core of our hospital was a centralized electronic health record (CEHR) available to all specialties. This model enabled both inpatients and outpatients to be followed up by physicians from any specialty. The CEHR is used in association with other applications in imaging diagnosis, laboratory results, histopathology, and nursing, thus enabling staff to work without hard copy (paper or film) in most situations.

The CEHR is completed by a departmental health record implemented in units with very specific requirements, such as intensive care and dialysis. These computerized tools are found on the central servers, can be accessed from several workstations via the hospital network, and are managed by the information systems department. Thus, the functioning of the system, data storage, and fulfillment of Spanish data protection legislation are guaranteed.[4]

## Development and Implementation of the Electronic Medical History in 1998

The essential elements of a fully computerized health records system are as follows:

1. Material resources: hardware. A local computer network connected to central servers is necessary. There must be 1 computer in every consultation room, office, admissions unit, dialysis room, and workstation. It must be designed in such a way that all professionals can work simultaneously under conditions of normal clinical practice.
2. Material resources: software. Specific programs to manage all the possible situations of data entry and retrieval in a conventional health record, namely, patient care applications.
3. Human resources: all health care staff must be able to use these applications.
4. Human resources: information systems department. Information technology specialists are an essential element of the process and must provide support to the users.

Hardware seems relatively easier to obtain in a new center. In this respect, specific recommendations are being made,[5] and even international standards are gradually being defined.[6] Software issues, on the other hand, are somewhat more difficult to resolve. This is such an important area that general recommendations on health care software are already being made in the USA.[7] However, the reality is that there is no universally accepted solution,[8] and this has been our experience since the opening of our center in 1998.

## Initial Implementation of an Electronic Medical History

The basic premiss is that each hospital has its peculiarities and there are no finely tuned applications that can be used throughout the hospital. Therefore, in our center, in 1998, we had to custom design a CEHR application (DOCtor, Hewlett Packard, Madrid, Spain) by means of a development plan and a working method.[1]

Once the final objectives have been agreed upon within a design group, communication between clinicians and information technologists is essential if a staged development plan is to be established.[9] The objectives and deadlines for each phase are defined in advance. Each stage of the plan includes the following periods: *a)* design; *b)* programming; *c)* pilot phase: live testing by the original design group extended to a limited number of users; *d)* initial fine-tuning (following the results of the pilot phase); and *e)* institution-wide implementation. The process is almost continuous and the preferred approach has been one of "growing" rather than "implementing." It is extremely important to define a good implementation strategy under real working conditions. In this sense, we must remember that large-scale projects have failed for this very reason.[10]

### Centralized Medical History: DOCtor

Despite the existence of commercial software packages that cater to the needs of specific working areas in a hospital (eg, laboratories, admissions, test appointments, pharmacy), global solutions that encompass the overall functioning of an organization are lacking. Experience in our setting is limited, and has normally only been gained in specific hospital units or departments. Particularly underdeveloped are general and multidimensional solutions enabling physicians to work in similar fashion in different areas (eg, emergency department, admissions, clinic, operating room, special tests).[11]

In fact, the work of a hospital is based on health records, and full computerization in a hospital is hindered by the key role these records play. The software used to manage the CEHR must fulfill a few basic requirements (Table 3). One of the most important requirements is the ability to adapt to different working contexts and sufficient flexibility for a coordinated effort by different specialists with regard to an individual health record.

## Transforming Hard Copy to the Centralized DOCtor Health Record

1. The basic action of the physician is the generation of annotations (not reports).

*a)* Any written comment on the conventional model (hard copy) has an associated time and identity record (signature). Annotations on paper are physically connected to each other (in a folder) and make up the main part of what we call the health record.

*b)* DOCtor works in a similar fashion, by generating annotations that are automatically associated with the date and time of the annotation and the signature (the application is password-protected). No one can modify an annotation made by someone else, and users have only a few hours to modify their own annotations. This last requirement guarantees the legal value of the CEHR, even more reliably than the traditional format.

2. Type of annotation.

*a)* On paper, information is structured in specific sections such as history, outcome, physical examination, complementary tests, or treatment. These give the structure uniformity and facilitate data retrieval.

*b)* In DOCtor each annotation is assigned a type identifier. This makes it easy to search, and more specifically, to automatically generate reports. Over time, the appearance of the screens can be changed, as can the structure of the report and the order of the annotations, while preserving data already entered. This simple procedure is impossible in a conventional hard copy history.

3. Reports (and documents): the report is a physician-generated document that serves to summarize the patient's situation at the end of a stay or after an outpatient diagnostic consultation. Other documents in the medical history include consent forms, recommendation forms, and diet forms.

*a)* On paper, the report is drawn up by copying and summarizing previous annotations. It is generally structured in sections (eg, history, examination). Administrative staff then transcribe the report from a dictaphone to paper.

*b)* In DOCtor, reports (and documents) are similar to files in a word processor. Once generated and corrected, they are recorded and closed to prevent loss or modification. These text files are usually structured according to section or type of annotation. When drawing up reports, the application (which does work previously performed by the administrative staff) will ask us which parts of the health record we wish to include and where we want to place them (design of the report). The application will then generate a text file according to our instructions. We can then correct the text and sign it. The application does not ask us to generate a report, except when we feel it is relevant. However, a summarized report or recommendation for treatment is usually submitted after examining the patient. Other text files can also be included, eg, informed consent documents (these must be printed, as the patient's signature is necessary) or recommendation documents.

**Table 3.** Basic Requirements of Electronic Health Records

| | |
|---|---|
| 1. | Equivalence between hard copy records and computerized records |
| 2. | Security. Control of access, inalterability of information, and user identification |
| 3. | Adaptability to working methods in different areas of the hospital |
| 4. | tructured information with 2 objectives:<br>– Clinical follow-up: ordered data retrieval<br>– Use of data to control and improve quality |
| 5. | User-friendly. Ease of use for nonspecialists in information technology; should not require more time than hard copy records |
| 6. | Open to improvements such as coding aids, patient care guidelines, or databases based on diseases |
| 7. | Compatibility to exchange information with other patient care applications (laboratory, radiology, prescriptions for treatment both inside and outside the hospital) |

## Other Elements of the CEHR

DOCtor provides the user with access by icons to other applications. The clinical request manager application makes it possible to request and retrieve complementary test data (diagnosis by imaging, laboratory, histopathology) from any part of the system. These results can be consulted, included with the annotations, or printed. The development of the application Centricity Web (General Electric, Madrid, Spain) has rendered film unnecessary in diagnostic imaging, as images can now be consulted from any monitor in the network. GACELA (Hewlett Packard, Madrid, Spain) allows nursing staff to follow up patients who have been admitted (eg, care planning, charts, results, remarks).

These elements provide several users with simultaneous and immediate access to almost all sections of the CEHR, and from any workstation. Figure 1 is a

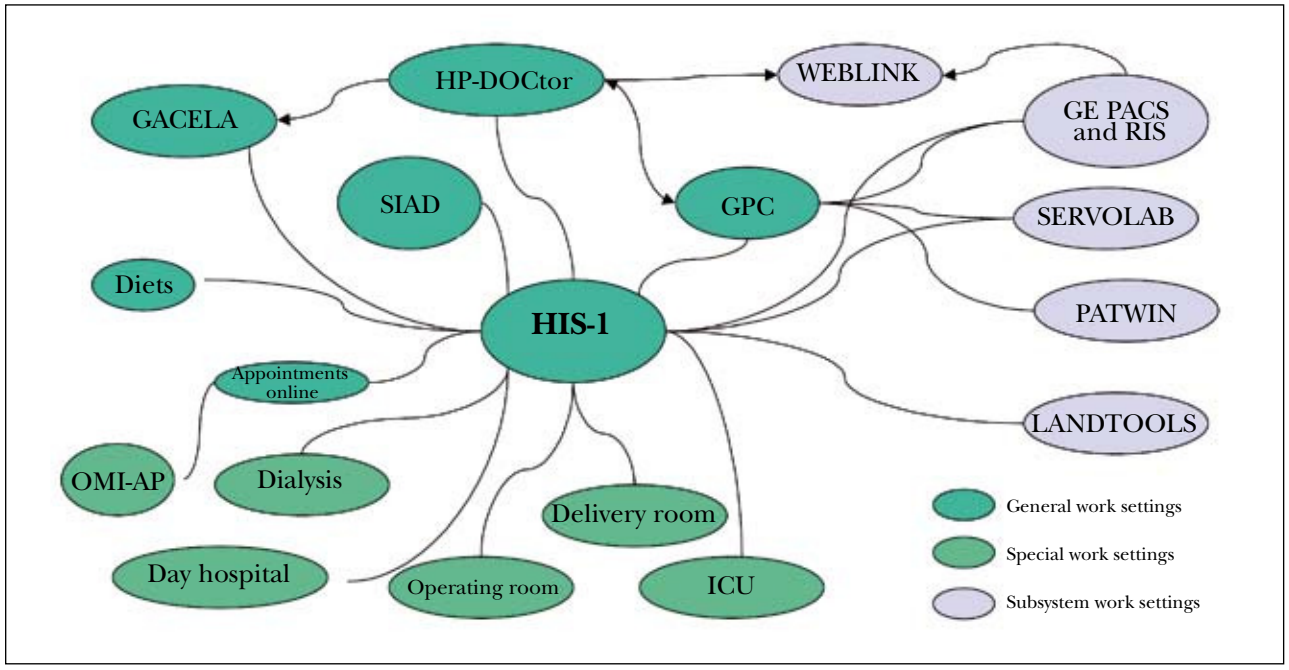


**Figure 1.** Functional structure of the information system of Fundación Hospital Alcorcón up to 2003. ICU indicates intensive care unit.

schematic representation of the first information system implemented, with particular emphasis on the application HP-HIS-1 (patient management) (Hewlett Packard, Madrid, Spain).

## Practical Implications and Problems in the Computerization of Health Records

As in any adaptation process, computerization of the patient care process can lead to problems that must be recognized and identified. These include the following:

1. Physician unwillingness. Users find it difficult to break the link with the former hard copy system. Some authors go so far as to emphasize mistrust on the part of physicians towards a transparent record system that does not allow subsequent correction.[12]
2. Patient unwillingness. Uneasiness and misgivings are detected among some patients, who only trust what they can hold in their hands: paper. Seen from another angle, both patient and doctor have to become accustomed to a new type of consultation (with the constant presence of the computer) and a new way of organizing time. In our experience, the user gradually discovers the advantages of this system and adapts to it.
3. Data retrieval. This problem has been minimized, as the system was implemented when the hospital was opened. Our experience is limited to the retrieval of data such as old reports from another hospital and the results of examinations carried out at other centers. These items are currently retrieved by scanning and incorporated in the electronic format. Previous examinations by imaging or in another format must be stored in the traditional health record after the report or summary is included in the CEHR.
4. Necessary coexistence of hard copy and electronic records. Despite the advantages of a computerized system, paper records remain indispensable, as a patient's signature is still required on a consent form. Therefore, standards should be defined for the coexistence of both systems.[13] Thus, all information, at least in its summarized form (eg, the report), must be found in the CEHR, irrespective of whether there is greater detail in the health record folder (for example, computed tomography scans taken at another center).
5. Implementation strategies. Users must become involved in the implementation process through contact with key users, who are responsible for reaching agreements with colleagues on general use and use by unit, thus creating a sense of ownership of the process.[9] The immediate advantages of the system should be made apparent (eg, data retrieval, generation of reports) so that users can see their efforts rewarded. Training is essential.

6. Defining techniques for checking and testing new software. If the project proves to be a success, the hospital will increasingly come to rely on it for the organization of daily work to the extent that it will become an indispensable tool. Every effort should be made to avoid faults and stoppages in the system. Test protocols must be programmed in simulators, real-time application must be tested by selected users, and maintenance downtime must be scheduled.

## Information System and CEHR of the FHA, 2004

The process to change information systems at the FHA began in 2003. Although the change was made to a large extent for reasons of technology infrastructure (switch from client-server technology to web-based technology), the main boost came from the need for a completely functional system for health care personnel. The switch was made to enable better integration between information and care systems and users (eg, clinicians, nursing staff, primary care staff), as well as to standardize a common model for future hospitals in the Autonomous Community of Madrid. Thus, with the application SELENE (Siemens, Madrid, Spain), which was first implemented at our center in 2003 and later at Hospital de Fuenlabrada, a single data processing center was created to serve the 7 newly opened hospitals in the Autonomous Community (including Hospital Puerta de Hierro, in Majadahonda).

In April 2003, the 4 main applications in client-server technology in the general work environment were replaced by a single web-based application, SELENE (Siemens). Furthermore, communication with the rest of the system was redefined using the HL7 standard and a single integration engine (OPENLink, Siemens). HP-DOCtor and GACELA-Tecnogest were finally installed in November 2003, and HP-HIS 1 in June 2006. GPC (iSoft, Madrid, Spain) for diagnostic imaging was finally installed in June 2006, followed by a system for laboratory work. System information is analyzed using DataWareHouse (Siemens, Madrid, Spain) separately from the information production applications of the system.

This initial image of the system is complemented by the integration of special work areas in the general application. A much wider view shows that the need for departmental applications (subsystems) is basically defined by the existence of complex interfaces with specific equipment (laboratory analyzers, monitors in the intensive care unit and recovery unit, radiodiagnostic devices). Figure 2 is a schematic representation of how the system worked after the change.

## Specific Resources in Dermatology

In the dermatology department, we have adapted and introduced a series of computerized documents and tools that facilitate health care and data analysis and complete the dermatology electronic health record (Figures 3 to 7).

### Specific Forms

A series of forms has been drawn up to collect information for specific procedures. It includes the following documents:

1. Outpatient surgery form (major and minor surgery)
2. Phototherapy form
3. Patch testing form
4. Digital dermatoscopy form

These are multiple-choice forms that allow patient care to be standardized throughout the department and data collection to be speeded up. They also generate an automatic report that is given to the patient, and make these processes easier to use (eg, statistics, charts), irrespective of the general data analysis program of the CEHR (DataWareHouse).

### Laboratory Tests

We have drawn up a series of standard profiles for the most common conditions. These make it easy to request tests and enable all the staff in the department to make the same requests when attending patients with these conditions.

### Coding

We have introduced automatic coding based on the International Classification of Diseases, 9th Revision, Clinical Modification for dermatology in the diagnosis of all the dermatologic processes, thus enabling a more systematic use and grouping of processes.

### Informed Consent

Templates have been drawn up of all the dermatology-specific informed consent models of the Spanish Academy of Dermatology and Venereology (AEDV). These are easily printed and are recorded in the CEHR.

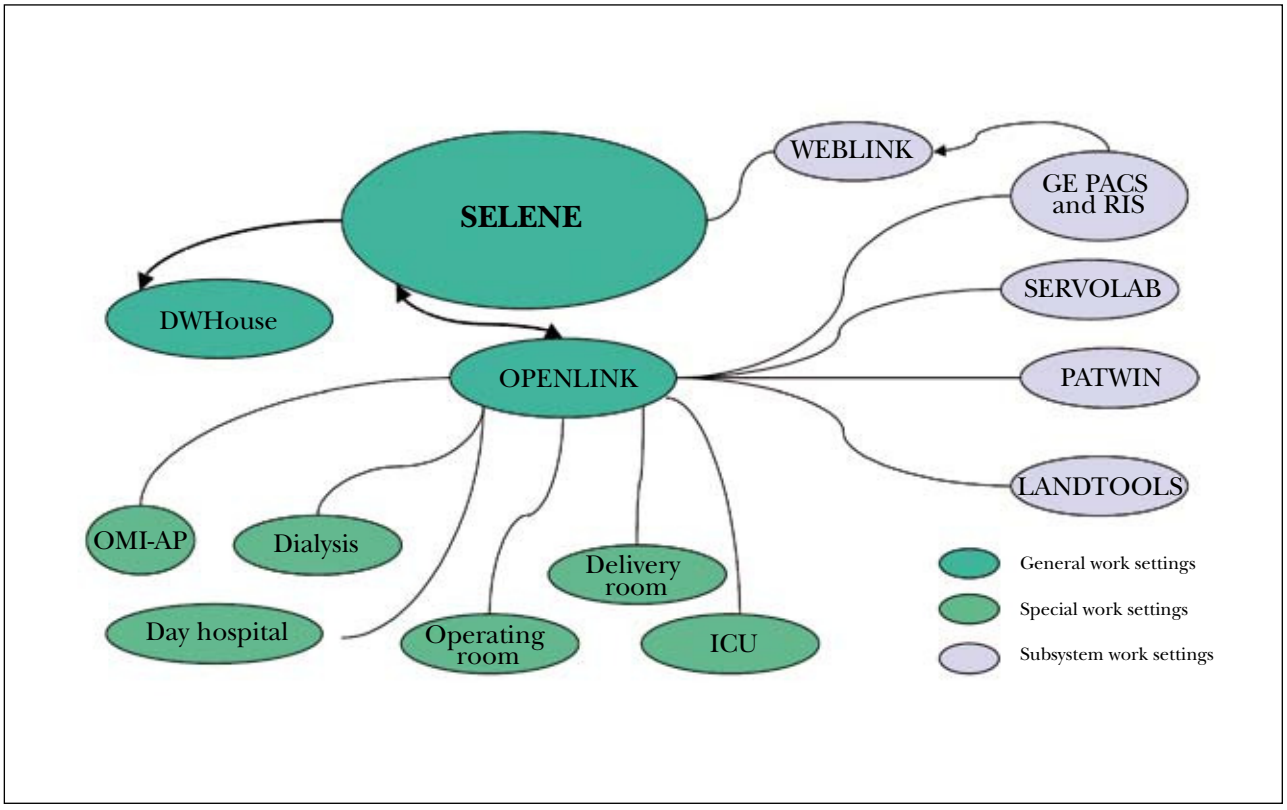


**Figure 2.** Functional structure of the information system of Fundación Hospital Alcorcón in 2006. ICU indicates intensive care unit.

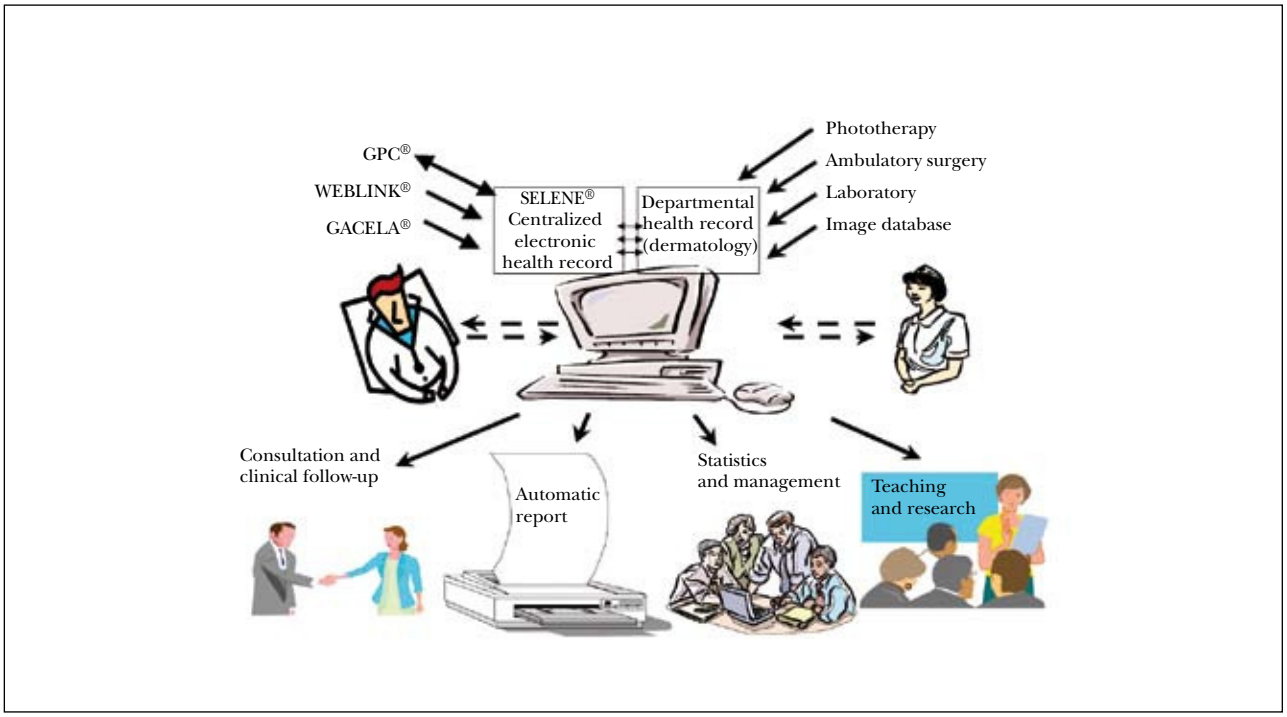


**Figure 3.** Structure of the centralized electronic health record system and the dermatologic health record system of the Fundación Hospital Alcorcón.

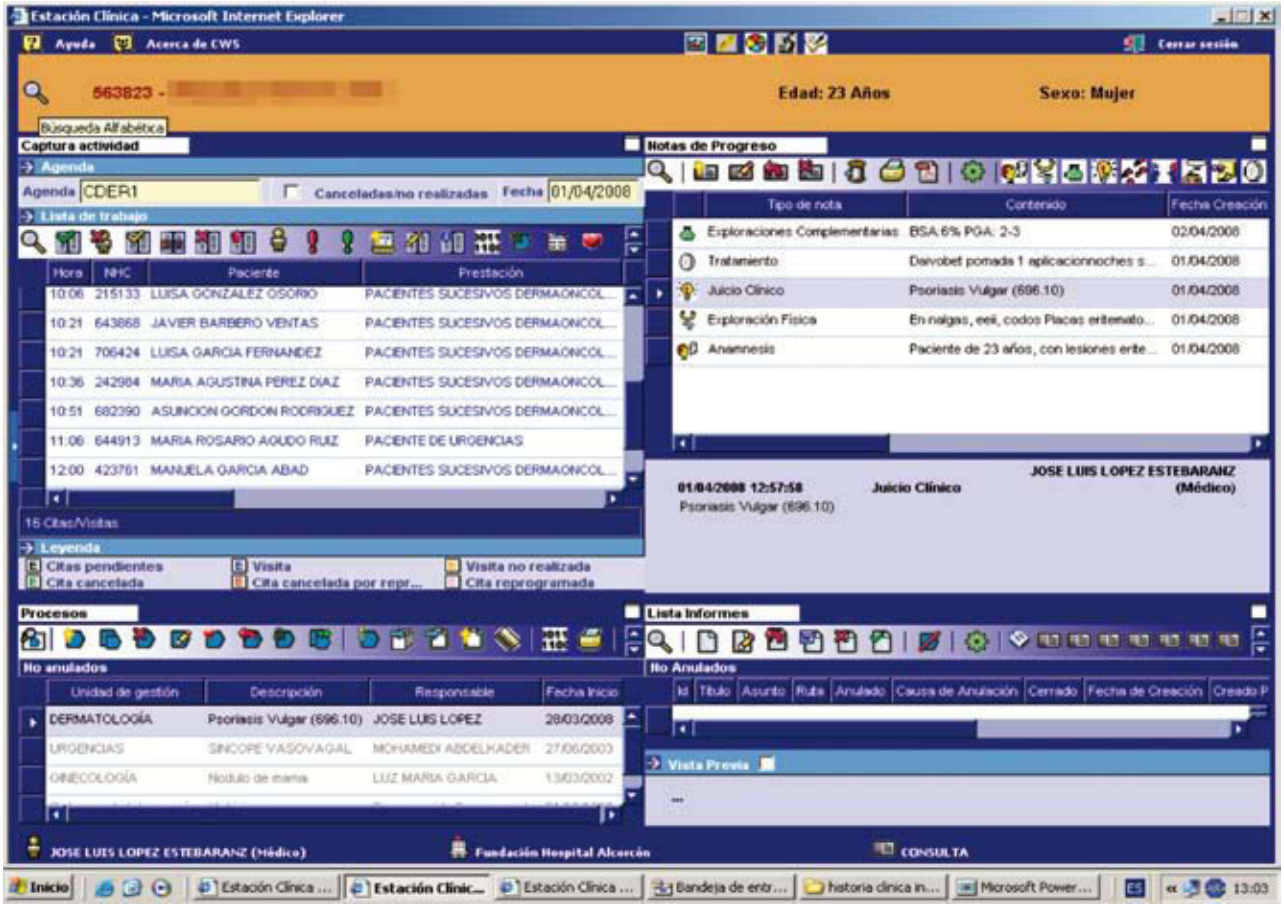


**Figure 4.** Screenshot of a centralized electronic health record at the Fundación Hospital Alcorcón.

## Other Tools

Other tools in the dermatology electronic health record include a tab that provides a ready calculation of the Psoriasis Area Severity Index and shows the result in the health record. The system also includes printable self-completed questionnaires on quality of life (Dermatology Life Quality Index).

## Dermatology Image Database

For the dermatologist, images are an essential part of the health record, much in the same way as a scan or a radiograph for the radiologist. Dermatologic imaging is not currently part of the CEHR (SELENE) at our hospital; therefore, we have had to prepare an interconnected parallel image database that was designed in ACCESS from the complete set of health records and is only open to staff from the Dermatology Department (password-protected). This database is maintained in the central servers of the information systems department and was set up in 1998 with all the necessary data for correct identification and interpretation of images. In the future, the ideal situation would involve total integration of the database in SELENE. One option, very similar to the way radiologic images have recently been incorporated, would be to use picture archives and communication systems to adapt radiologic images and the viewing program, Centricity Web, which is linked to SELENE. Our current database contains more than 43 000 dermatologic images and occupies more than 34 Gb.

## Conceptual Aspects of the Electronic Patient Record and Conclusions

A computerized health record system cannot be conceived as a mere report manager or advanced word processing system.[14] At our center, the CEHR was designed as a patient-centered, problem-structured, relational database. The main contribution of our health record system is that it naturally considers patients on an individual basis and can be accessed by physicians from different specialties thanks

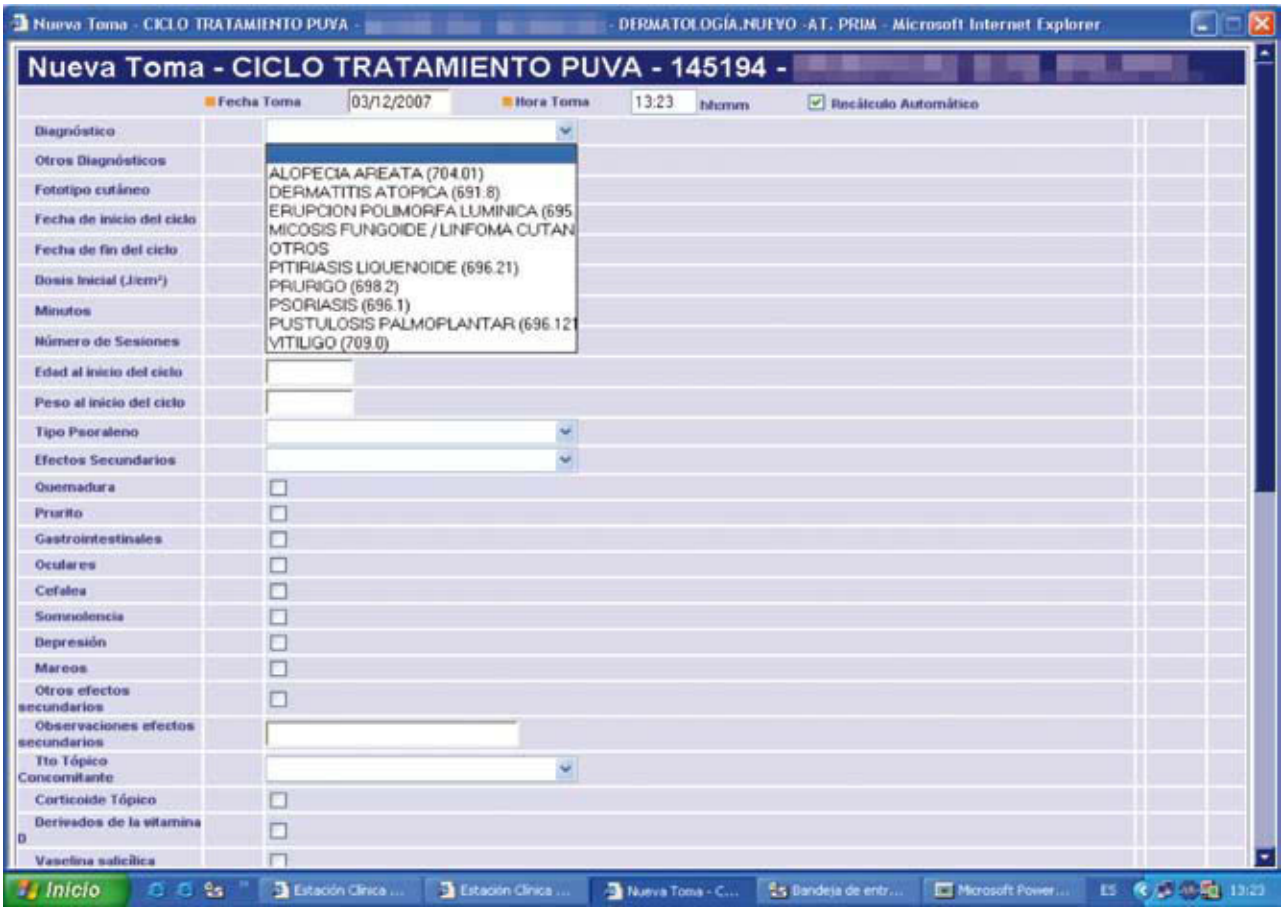


**Figure 5.** Screenshot of a form for a cycle of treatment with psoralen-UV-A.

to a common design that makes it possible to produce specific forms and provide personalized information by department and unit.

Another conceptual contribution of the CEHR is the identification of the annotation as a unit of work for the physician. These paragraphs of free text written by the physician have different attributes (eg, user name, user specialty, date, time), including "type of annotation," which will prove more useful for generating semiautomatic reports and "views" of the health record. Other authors already consider such a development as extremely necessary.[15] User interaction with the application should enable it to be modified so that it can be adapted to specific needs. This area should receive most attention during the design phase.[16] An additional benefit of this approach is that it nurtures a sense of ownership of the application among medical users.[11]

Overall, our application meets the basic requirements of a computerized health record system and satisfies the expectations this tool generates among users. Furthermore, it is an authentic legal back-up that enables us to move away from hard copy, except for the cases mentioned above (eg, informed consent documents).

It is particularly important to encourage monitoring of local clinical practice guidelines, a task that was started in the departmental application and that is consistent with other partial experience in this area.[17-19] However, this system is still far from realizing its potential,[20,21] and new tools will be developed in the near future. These will act as "wizards" for the installation of programs on a home computer to help the physician monitor patient care processes, such as management of anemia or monitoring of vascular access.

Those of us who use these tools are highly satisfied with the added value they give our work, and we find it difficult to imagine our day-to-day activity as physicians without them. The possibility of immediate access to legible information as soon as it is generated is one of the most appreciated operational advantages in our routine.

An essential aspect that has yet to be resolved is that of compatibility between the different applications. Connec-


**Figure 6.** Screenshot of a dermatology surgery form.

tion between different databases is almost always technically possible, yet often limited by commercial interests. Therefore, scientific societies or public health systems should establish and demand minimum requirements for communication between different CEHR models.

Another area that has recently generated interest and that can be developed in the future is the connection of these systems with the Internet. Practical experience in this field is already available,[22] although the main question concerns the secure transmission of confidential data. Available commercial applications enable data to be coded, encrypted, and transmitted securely. This will make it easy to transmit reports, tests, and even the complete health record of a patient who is transferred or admitted to another center.

We must not forget the costs involved in this computerization process. In North America, these were calculated to be between $15 000 and $50 000 per physician, as well as the 10% to 20% reduction in productivity observed during the first months when transferring from a traditional hard copy–based system.[23] Therefore, it is better to undertake smaller yet feasible projects before implementing large-scale plans, which are generally doomed to failure.[24]

Lastly, we must stress that the success of a computerization process and implementation of the CEHR depends primarily on the will and cooperation of the health care professionals involved, the existence of efficient and advanced technology, and a certain degree of patience from all those who participate in the process.

## Acknowledgments

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**Conflict of Interest**
The authors declare no conflicts of interest.

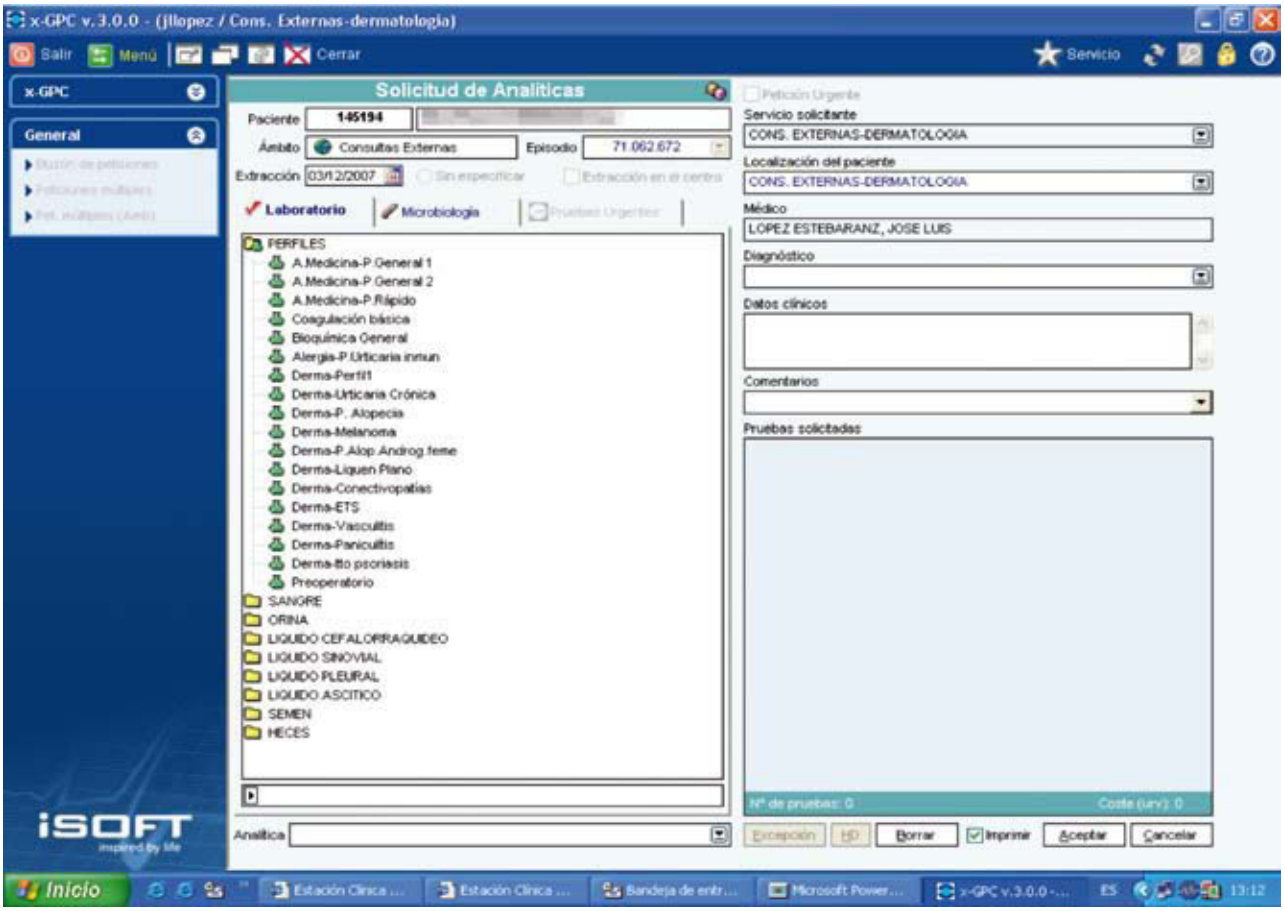


**Figure 7.** Screenshot of a centralized electronic health record with laboratory profiles specific to dermatology in Fundación Hospital Alcorcón.

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