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Development of a standardized format for archiving and exchange of electronic patient records in Sweden

Ted Wigefeldt [1,3], Sten Larnholt [2], Hans Peterson [1]
[1] SPRI (The Swedish Institute for Health Services Development), Box 70487, S-10726 Stockholm, Sweden
[2] Sahlgrenska University Hospital, Östra, Department of Geriatrics, S-41133 Göteborg, Sweden
[3] Genisys Software AB, Box 2401 S-40316 Göteborg, Sweden

Abstract. This paper describes an effort to standardize the long term archiving format of the electronic patient record. A format is given in SGML (Standard Generalized Markup Language) and also tested as a prototype in a production system.

1 Introduction

During the last decade 85 % of the primary health care units and about 15 % of the hospital care units in Sweden started to use electronic patient record systems. These systems generate a large amount of information that is stored on data media.

In many regions in Sweden there are regulations that medical records should be available for a very long period of time. The medical information that is stored on data media must be readable on any technical platform and by any electronic patient record system. 'The Swedish National Archives' approved archive methods are today microfilm and paper. One of the disadvantages with this form of long term information storage is that it is practically impossible to sort out information on research a perspective. Structured information in electronic patient record systems is easily handled for the purpose of statistic use and research.

To solve the problems with long time storage of medical information that is stored in different electronic patient record systems SPRI (The Swedish Institute for Health Services Development) in collaboration with Sahlgrenska University Hospital created the project DEJAVU.

The purpose of this project is to develop a general format, which will enable storage of medical information on a long time basis. The format, technology and the test system are described in this paper.

2 Background

Within an application the medical information will probably be divided into two types of archives - a primary archive and a secondary archive.

The primary archive's physical division of the elements into items and item complexes will follow the proposed standard of CEN TC251 Env 12265 (EHCRA). The main benefit is the direct mirroring of the elements into the database. Searches and handling of this database will be efficient in extracting individual objects. The drawback is the high degree of references and associations to maintain. One must also have access to a unique tool to interpret the information.

The secondary archive will accommodate information stored in a format more suitable for long term storing. The structure must be as flat as possible and referenced information must be stored in one unit together with the referring element. The format must also be robust and readable without specialized tools.

3 Problem definition

3.1 Different types of medical records

The most common model will in the future be the *object oriented* medical record. Within this category we will find a dispersed amount of objectorientation. The simplest form consisting of elements categorized by titles to the more advanced virtual medical record. One adaptation to objectorientation is the CEN Env 12265 framework. But the object orientation gives models complicated structures with elements connected in multiple dimensions.

Document oriented records is by nature stored in a single dimension flat format. Each document consists of 3 types of information, *data, structure and format.*

Data could be text, graphics, pictures or multimedia objects as well as video and sound.

The *structure* forms the relations between the document elements. Examples are paragraphs, lists and headlines.

The *format* gives the document an appearance. Examples are fonts, indentation and italics.

3.2 Our objective

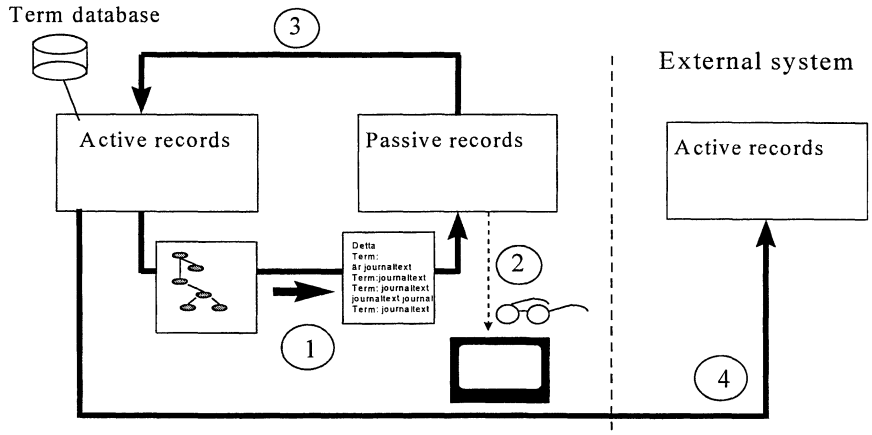
The main problem to be solved is the translation of the objectoriented medical records multidimensional network structure into the flat structure of the dokument. At the same time most of the information elements and their references must be preserved. We also want to achieve this in an technologically independent and standardized way.

One goal for the project has been to use as much standard tools and methods as possible in describing the format for archiving and transportation. One such description tool is SGML (Standard Generalized Markup Language).

4 Model

The purpose of our work is to find a way to transform structured data into a standardized document format. This format will allow us to transport information between various vendors' applications and operating systems. In this format a document could be considered to have an unlimited lifetime.

A suggestion for such a model can be described in four steps. It is in this environment that the proposed format is set to work.



1. The electronic patient record is extracted out of the original structure and then transformed into SGML format. The existing term catalogue is the basis for labeling the information with SGML-tags.
2. An SGML (HTML) viewer is integrated with the available EPR system to make the archived records visible on demand.
3. The system has the power to parse and unpack achieved records or parts thereof to regain as active record elements.
4. The archive format will be tested in transporting record information between two physically separated systems.

4.1 SGML

SGML (Standard Generalized Markup Language, ISO 8879:1986/A1:1988) which is an international standard since 1986, is a declarative language that in a standardized way makes it possible to lay out the structure for electronic dokuments.

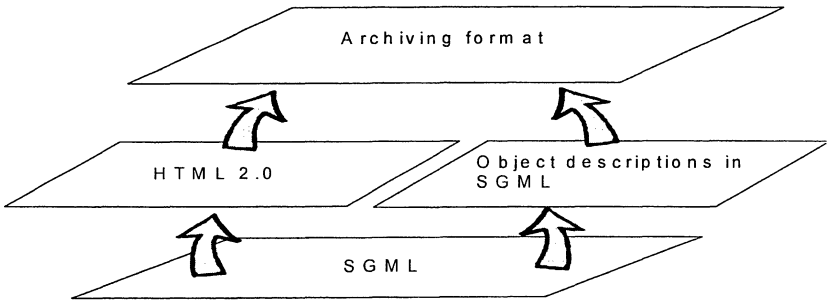
The two main parts of SGML is the DTD (Document Type Definition) and the documentation itself. The DTD describes the elements and the structure of every type of document. Within the document text is mixed with markers or tags which are described in the DTD.

5 Result

One outcome of the project is a SGML-DTD suited for term based patient record information. This DTD makes it possible for an objectoriented record to maintain its advanced structural design in the translation from database format to the document format. The DTD describes all the concepts defined in Env 12265.

The object descriptions in the DTD are completed with the DTD for HTML (Hypertext Markup Language) 2.0. In doing so, all archived documents will be viewable with HTML browsers. In this way we apply an established and cost-effective technology, and at the same

time we can maintain a structure laid out in Env 12265. All this secured for long time and with the possibilities for additions.



A very simple example showing the combined format will follow below. The only intention here is to show the principle.
In this example we will archive the bloodpressure of a patient. In the medical record the bloodpressure is shown as:

Bloodpressure 120/80

The pure HTML code to show the above pressure and value is:

```
<TABLE>
<TR>
<TD COLSTART="1">
<STRONG>Bloodpressure</STRONG>
</TD>
<TD COLSTART="2">120/80</TD>
</TR>
</TABLE>
```

The pure object format in SGML is expressed as:

```
<ITEM>
<TERM TERMID=1000 TERMNAME=Bloodpressure>Bloodpressure</TERM>
<TERM TERMID=1002 TERMNAME=Systolic>120</TERM>/
<TERM TERMID=1003 TERMNAME=Diastolic>80</TERM>
</ITEM>
```

The combination of HTML and the SGML patient record DTD gives us:

```
<TABLE><TR>
<TD COLSTART="1"><STRONG>
<ITEM>
<TERM TERMID=1000 TERMNAME=Bloodpressure>Bloodpressure
</TERM></STRONG></TD>
<TD>
<TERM TERMID=1002 TERMNAME=Systolic>120</TERM>/
<TERM TERMID=1003TERMNAME=Diastolic>80</TERM></TD>
</ITEM></TR>
</TABLE>
```

6 The prototype

To test if the proposed archiving format is functioning and if it can form a suitable base for a standard, the ability to handle the archives have been added to a modern electronic record system.

The Melior EPR system from Siemens Nixdorf Informationsystems AB adapts to the CEN EHCRA framework. The term catalogue describes the structure and relations between the medical items. The term catalogue has been completed with descriptions of markup tags. The documents can then be built from the descriptions in the term catalogue.
Together with security adaptations a viewer is added to the system, which gives the possibility to show the archived record.

There is also the facility to activate the archived record by move it back into the original database structure. An SGML parser - an interpreter or translator - decodes and unpacks the elements and rebuilds the database structure with all references.

The same method has with success been tested to transport records between physically separated systems.

7 Discussion

If we have a standardized archive format - when is the right time to store ? Will it be after some time, say every year, or will it be every time the information is signed?
How much of the record must be saved in one piece?

Another problem that can be solved with a standardized archive format is taking backups in an uniform way. Today the backup is taken mostly in native format direct from the database. With an archive format a backup can be taken independently of vendor and type of database or record system.

The most common format for exchange of medical information between systems is the EDIFACT and HL7 protocols. A standardized archiving format could probably serve as compliment to ease the exchange of structured medical information, especially if the structure is unknown from the beginning.

8 Conclusion

By development work and through testing we have found SGML suitable as a tool for long term archiving of electronic medical record documents. We have also developed a DTD (Document Type Definition) in SGML, which we consider to be a beginning to a common and standardized format to be used in long term archiving of patient records. Everything seems to indicate that the format can be used as an exchange format when moving records between separate systems. The format is also sufficient flexible to let us store structured records.

9 References

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