

A comparative study of EPR projects in Denmark

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Abstract. The EPR-Observatory – a public funded project organization - has monitored Danish EPR-projects with respect to various parameters such as diffusion and diffusion rate, barriers and limitations, experience gained. Furthermore, the Observatory has aggregated and disseminated the results and has established a constructive dialogue between the Danish EPR projects. The Observatory has also focused in the later years on analysis of common frames of reference for EPR systems. The National Board of Health and some of the larger counties have developed such frames. First generation systems have been implemented in a few counties with moderate coverage, but a number of projects developing second generation systems are making progress, and the market situation is quickly maturing. There are still, however, major problems in the practical implementation of the systems.

Introduction

In 1996 and 1999 The Danish Ministry of Health launched national strategies for the development of EPR (Electronic Patient Record) in the Danish health care sector (1,2), the last covering the period 2000 - 02. With a basis in these strategies, the EPJ-observatory (3) was launched as a horizontal activity to collect and disseminate experiences from the regional EPR-projects. The EPR Observatory has collected data: in 1998 focus was on the expectations and in 1999 focus was on the experiences. These results are published in two Annual Reports (4,5) (in Danish) and summarized in (6). For the period 2000 – 02, the EPR Observatory focuses on the analysis of EPR-development and implementation in the Danish healthcare sector. This work is paying attention to:

1. Implementation and dissemination issues:
 - Diffusion and diffusion rate of EPR-systems
 - Experience among the different stakeholders
 - Factors that increase diffusion and use of EPR-systems
 - General barriers for diffusion and use of EPR-systems
 - Assessment of selected EPR projects
2. Issues related to common frame of reference for EPR-systems:
 - To uncover differences and compatibilities between regional data models
 - To communicate consequences of using incompatible data models, and to assess the demand for a common frame of reference.

The EPR Observatory has established networks, knowledge exchange and dialogue between the various EPR-development projects, local decision makers in the hospitals and the central health authorities. Initial transfer of strategic EPR-experience from the other Nordic countries has also been carried out. Finally, results of the above activities have been disseminated to all groups in the Danish health care sector through a national conference as well as through an annual report 2001(7) (in Danish). This paper gives a summary of the main results from this report.

Methods and materials

EPR-Observatory 2001-survey covered all the EPR-projects in Denmark. The basic idea was to focus the questionnaire survey on the status for the present year and the respondents' expectations for the coming year. In this way it was possible to monitor the development in the projects and to enable an in-depth analysis of what causes sudden or swift progress in the projects.

The main survey used an Internet based questionnaire, which was launched in two steps. In the first step every county administration (n=15), every hospital (n=100), and every hospital department (n=657) was included. This part aimed at identifying EPR-projects and classifying them according to developmental status: in-use, currently being implemented, and planned. In the second step a questionnaire was directed at the identified local and regional projects (n=52).

Four data models were analyzed and assessed:

1. Domain Object Model – Århus County
2. Standardized transfer of patient data - Vejle and Viborg Counties
3. Distributed Health Environment – H:S (Hospital Cooperation in Copenhagen)
4. Basic frame of reference for data transfer in EPR – National Health Board

The analysis of these data models was impeded by the fact that the models:

- Have different aims
- Are documented through different methods
- Developed extensively during the observation period.

Data for description, analysis and assessment was collected in workshops and through interviews.

Results

The questionnaire survey posed a number of questions regarding regional strategies, existence of EPR projects, EPR diffusion, economy, and workflow analysis.

IT strategies: 11 out of the 15 counties have made an IT strategy for the health care sector. The strategies are not static, but are typically revised every second or third year. 90% of the hospitals (n=53) and 80% of the departments (n=443) state that these strategies will have consequences for their organization in the period they cover.

Identified projects: The survey revealed 52 EPR projects in the country. The projects are in different phases and are controlled on different levels as indicated in the table below.

	Running systems	Under construction	Planned	Total
County project	1	1		2 (3%)
Hospital project	6	4	3	13 (24%)
Department project	24	12	1	37 (72%)
Total	31	17	4	52

Table 1. Identified EPR projects – developmental phase and management level

Diffusion of EPR systems: Between 5% and 10% of all beds in Danish hospitals are covered by an EPR system. There is a great variation among the hospitals and the counties. In one county (Viborg) the coverage is 50% and several counties respond 0%.

Economy: The counties and the hospital managements were asked about the cost of running the IT systems and the annual investment in IT infrastructure and systems development. The answers indicate that around 1% of the total hospital turnover was spent on run-

ning the IT systems. Investments in IT infrastructure and systems development are approximately 0,3% of the turnover. Very few answers were returned in this area – counties (n=8) and hospitals (n=40). One reason might be that the accounting system in public administrations does not easily allow for retrieval of this kind of information.

Workflow analyses are regarded as an essential activity in the implementation of EPR systems. The questionnaire survey revealed that workflow analyses are done on a very pragmatic basis without formalized methods. The most common methodological basis for doing the analysis was business process reengineering (BPR) (36%, n=22). Only 14% of the projects applied the object oriented “use case” approach. The majority 41% indicated they used their own methods for the analysis.

The data models for three major EPJ projects in Denmark and the preliminary standardization initiative taken by The National Health Board were analyzed and compared. The model represents different system development philosophies and scopes.

Comparison of data models

The open data model: Århus County is developing a common EPR-system for all the hospitals in the county. High staff involvement at all levels has been prioritized to achieve best possible implementation results. One of the main characteristics is the development of a general conceptual model – the Domain Object Model (DOM) including a general framework for the work process structure in the county hospitals. The model functions as the basis for a development tool for individually tailored EPR modules (abbreviated as HBD in Danish), obtaining integrity between the individual modules and enabling communication to other proprietary systems. A further aim of the model is to facilitate the involvement of the clinicians in the development process. The DOM specifications are public, in order to promote a multi-vendor situation where the county owns the “integration key”. The DOM specifications can be seen at [<http://www.epj.aaa.dk>].

The communication model: At present the hospitals in Vejle and Viborg counties use a number of different proprietary systems. They need a way to retrieve and compare datasets and to transfer data for supporting, planning and quality assurance of patient treatment. The two counties initiated a joint analysis to achieve a basis for deciding on how to exchange data from proprietary systems – the SUP projects (Standardized Retrieval of Patient data, abbreviated as SUP in Danish). Following the analysis, it was decided to launch a test project, currently in progress, where data are retrieved in XML format and stored in a dedicated SUP-database. A number of health IT systems, including the EPR systems in use, are appointed as data suppliers. The results of the test will be available in spring 2002.

The middleware model: The Hospital Cooperation in Copenhagen (H:S) has chosen a middleware solution as the strategic integration solution. The middleware complies with relevant national, European and international standards. The product used is Distributed Healthcare Environment (DHE), which has been developed in Europe during the last 10-15 years. This development was supported by a number of European research projects in the 80's and 90's and has been commercialized by the Italian company GESI. DHE is an integration platform based on HISA (Healthcare Information System Architecture). The aim of DHE is to provide efficient data transfer between proprietary systems as well as between EPR-systems to come. New systems or modules use the DHE as development platform.

The semantic model: The National Health Board has developed a Basic frame of reference for data transfer in EPR (B-EPR). It is basic, because it only describes the most important parts of a frame of reference. It describes a minimum data set for transfer. The data are in this case the data regarded as common in the transfer of patient record information. The frame of reference is represented in Unified Modeling Language (UML), and the model is based on a patient flow and problem-oriented way of documenting the activities.

Assessments, plans, procedures and evaluations can be documented successively.

[<http://www.sst.dk>]

The main purpose of the national frame of reference is to define standards for transfer of data between different EPR-systems, EPR-systems and clinical databases, EPR-systems and other hospital information systems, and between EPR systems and a national registry of patient flow data. The standards will primarily determine the data elements that can be transferred. Secondly, the standards will also give directions for the EPR-system itself. The patient flow documentation will require the data to be stored with reference to patient flow and not, as is the case in many contemporary systems, with reference to a single event. However, the standards will not determine any relation to the system architecture, the design of data entry or user interfaces.

Discussion

The majority of the counties in Denmark have made a strategy for the development and implementation of EPR systems. This indicates that EPR systems are taken seriously in county managements. Moreover, it is significant that hospital managements as well as departmental managements consider the strategies in the EPR area as an initiative that will have significant impact on daily routines. However, if these very positive expectations are not met, there will be a serious risk to the entire EPR project from negative reactions from the daily users of the EPR.

Although the response rate for the questionnaire survey is not 100%, we do not know, by informal communication, of any project that has not been identified in the survey. Greater uncertainties are, on the other hand, characterizing the diffusion of EPR systems. The definition of EPR system covers various generations of systems with different functionality. Therefore the results have poorer validity. Some of the counties have implemented first generation text based systems, while other counties are in the beginning of development and implementation of more advanced systems, complying with international standards for classification and communication. In the future a more advanced scale should be applied in the surveys to distinguish the systems.

The investment in IT in the Danish health care sector is surprisingly low. Although the data gathered in this area is not precise and exhaustive, the 0,3% of the turnover spent on IT in the health care sector is extremely low compared to other service industries like insurance and financial companies, which generally spend around 8-15% of their turnover on IT(7). In the future national strategies will need to involve the political level to a greater extent than previously, in order to obtain the necessary funds.

The implementation of EPR systems usually involves major changes in the organization. Workflow analysis has been one of the most popular approaches to handle organizational change. However, the methodological background has not very matured. Many projects have chosen a BPR approach, regardless of the problem at hand or the character of the workflow. Health care professionals in general do not have adequate professional insight in this area and tend to rely on organizational consultants. BPR is among the most popular theoretical approaches to workflow analysis. Only few projects have drawn on alternative theoretical approaches such as "object oriented analysis" or "use case". The pragmatic approach used by the majority of projects has the drawback of not being explicit. Hence it is complicated and in most cases impossible to transfer any knowledge from the results to neighbouring or related departments.

There are in principle two different approaches to building data models: 1) Communication approach in order support an efficient information transfer and communication of patient related data across institutions and sectors within an EPR environment. 2) System approach in order to give the basis for the data structure and the system architecture. In the same way, we have different scopes of the data models: 1) either an abstract generic model

or 2) to give support to implementation process. In fig. 1 we have placed the four different models in this abstraction/purpose framework. From this we can see the very different scope and purpose of the individual models. For the purpose of reference, “MedCom” refers the communication between the primary health care sector and GP’s. From a public point of view we could raise the question: why have so many different approaches in as small a country as Denmark with a publically paid primary health care system?

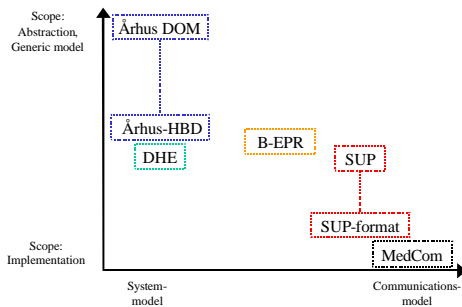


Figure 1. The various data-models placed in an abstraction/purpose space.

structures for the data and the relations within the EPR system, and thereby the data to be transferred to other EPR-systems. In this way, the use of models means that the EPR databases are based on open standards, which in turn means that change of vendor can be effectuated more easily.

There is also a tendency to see new companies on the market for EPR systems. This also indicates that the situation is becoming mature for market trade of EPR systems. An estimate of the market could be that it will grow exponentially, only limited by the vendor’s ability to deliver and implement EPR systems.

Conclusion

The EPR Observatory is monitoring the development, implementation and diffusion of EPR systems in Denmark. On the national level there has been an EPR strategy for the last five years. The majority of the 15 counties have now developed and disseminated regional strategies for EPR development and implementation. A large number of development and implementation projects have been started, and in some counties the diffusion of EPR systems is approaching 50% of the beds. These systems are mainly first generation systems, but a number of the larger counties have started the development of data models as a basis for development of second generation systems, supplemented by the National Health Board’s frame of reference.

To optimise the learning effect from more projects, it is essential that the projects are open and willing to disseminate results currently. We expect to learn from project experience, what the optimal strategy would be for dividing between a central common approach and an individual tailoring of systems.

The market situation for EPR systems in Denmark is maturing and the demand will probably grow tremendously in the years to come.

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References

- [1] Danish Ministry of Health. Action Plan for Electronic Patient Records - Strategy Report. Copenhagen. Danish Ministry of Health. 1996;
- [2] Danish Ministry of Health. National IT Strategy for the Hospitals 2000-2002. Copenhagen. Danish Ministry of Health. 1999;
- [3] A National Project for Promoting EPR Development. The Danish HOP Project. 1998; Proceedings from EPRIMP. The International Working Conference on Electronic Patient Records in Medical Practice, Rotterdam 1998.
- [4] Vingtoft, S. et al. The EPR Observatory. Annual Report 1998. Aalborg University. 1998.
- [5] Vingtoft, S. et al. The EPR Observatory. Annual Report 2000. Odense. The County of Funen. 2000.
- [6] Nøhr, C., et al.: Shared experience in 13 local Danish EPR projects The Danish EPR Observatory., MedInfo 2001, London, sept. 2001.
- [7] Bernstein, K., et al. The EPR Observatory. Annual Report 2001. Odense. The County of Funen. 2001.
- [8] Iakovidis I. Towards personal health record: current situation, obstacles and trends in implementation of electronic healthcare record in Europe. International Journal of Medical Informatics 1998; 52:105-15.