

# **A Frame for Evaluating the Implementation of an Electronic Patient Record: The use of Theory Based Evaluation within Healthcare**

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## **Abstract**

In recent years, important investments have been made in implementing IT systems within the Danish healthcare sector. The objective with these systems is to improve the quality of the healthcare and to increase the patient quality. For various reasons, such as defending an IT implementation's worth or showing indicators on improved performance, managers within the healthcare sector have an interest in evaluating how well the implementation turned out to be. Such an evaluation should include information about the value with regard to both the implementation process and the effects. In relation to this, the paper in question presents the theory based evaluation as a frame for evaluating the implementation of an Electronic Patient Record (EPR) at a Danish hospital. The evaluation is exemplified on the basis of the Digital Hospital Project, which took place at a hospital in North Jutland, Denmark, from 2001-2003. The purpose of this paper is twofold: First of all, the aim is to outline how to conduct an evaluation of an EPR implementation within the frame of theory based evaluation. Secondly, emphasis will be put on the implementation process in relation to the effects. In other words, it is important to take into consideration both the effects and the process when evaluating an EPR implementation. In this way, the paper provides a frame for evaluators and other practitioners on how to tailor and conduct evaluations to determine the worth of an implementation program. The study concludes with a discussion based on our experience in using the frame of theory based evaluation within a healthcare context along with an outline of the implications when it comes to the effect -and process evaluation.

**Keywords:** Electronic Patient Record, implementation process, program theory, theory-based evaluation, Danish healthcare sector.

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## 1. Introduction

Recently, there has been an increased demand for a full exploitation of the possibilities of information technology (IT) in the Danish healthcare sector. Politicians and hospital managers perceive IT as the key tool for handling the increased need for better services and for complying with the political objectives regarding high quality, better information flow and a higher level of patient involvement (Indenrigs- and Sundhedsministeriet 2003, p. 3). The objective with IT systems is to improve the quality of the healthcare tasks and to increase the patient quality. One of the main IT systems being implemented in the Danish healthcare sector is the Electronic Patient Record (EPR) which is presumed to make the clinical work processes and communication channels more systematic and efficient, thereby raising the quality of the core hospitals services (EPJ-Observatoriet, 2000).

When implementing IT systems within organizations, questions are raised concerning whether the implementation is working as intended and why this is the case (Grembowski, 2001). In other words, it is deemed important to evaluate how well the IT implementation turned out to be. Such an evaluation should include information about the implementation with regard to both the effects and the implementation process. Evaluations help the hospital managers to improve or refine an implementation based on an understanding of its performance. Similarly, evaluations serve as a decision-making tool for a further allocation of resources and for determining whether to extend, cut back or totally abolish a specific implementation program.

In relation to the aspects outlined above, the purpose of this paper is to present the theory based evaluation<sup>2</sup> as a frame for evaluating the implementation of an EPR at a hospital. Similarly, the aim is to discuss how one can supplement the theory based evaluation with aspects relating to the process. More precisely, the aim is to put emphasis on how to conduct an evaluation which takes into consideration both the effects and the process of an EPR implementation. This is exemplified on the basis of a two-year project, the Digital Hospital Project (DHP), which took place at a hospital in North Jutland in Denmark. The authors accomplished the evaluation of this implementation and developed a concept for evaluation within the framework of theory based evaluation. In this way, the paper is

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<sup>2</sup> Theory based evaluation attends the essential questions: What has effects for whom? –how? –when? and under which circumstances? (Dahler-Larsen, 2003) The concept is elaborated further in section 2.

considered useful for practitioners and evaluators as it addresses how to tailor and conduct a concept for evaluation with regard to EPR implementations.

In the following sections, there will be a brief case presentation of the project The Digital Hospital which will lead to an outline of the theory based evaluation and its main aspects in relation to the case. Special emphasis will be put on the effort to combine both the aspects of the effects and the process when conducting an evaluation. The paper concludes with a discussion of the work accomplished and with arguments for further investigation based on our experiences with this evaluation frame. Implications for focusing on both the effects and especially the process will be elaborated on.

### **1.1 The Digital Hospital Project**

The Digital Hospital Project was initiated in 2001 and lasted until the end of 2003. Its overall aim was:

*...To increase peoples' satisfaction with the Danish healthcare sector. This is achieved through a massive IT effort e.g. system integration on one single hospital. Increased access to data and better exploitation of resources is created, resulting in increased efficiency and patient satisfaction (DHP project description, page 2).*

The Digital Hospital Project was situated at a hospital in Frederikshavn, which is part of Vendsyssel hospital in North Jutland, Denmark. The project amounted to approximately DKK 40 million. This money was spent on the launch of a range of different IT solutions such as the EPR, electronic booking, patient terminals, a telemedicine solution for diabetics, digital dictate etc.

There was a distinct wish for an evaluation of the effects of the implementation of the IT systems:

*To get concrete knowledge of the effects of the systems in order to get a more precise evaluation of the possibilities of increased efficiency and better quality in the treatment and care of the patient. Collection and*

*evaluation of the data is carried out by an independent, academic project partner in order to make the effect evaluation as objective as possible (DHP project description, page 28).*

The evaluation was expected to uncover possible improvements in several areas: Patient information, hospitalization, the quality in patient treatment and care, and efficiency in running the hospital.

The following systems were selected for the effect evaluation: EPR (only the surgical area), booking, digital dictate and the telemedicine solution – DiasNet. In this paper focus is on the EPR.

The task of managing the effect evaluation of the EPR was large and complex. It was not easy to identify the effects and it was difficult to point out the areas where they were supposed to appear. Finally, it was difficult to trace possible effects back to the launch of a concrete IT solution. Similarly, organizational aspects could interfere with possible effects, making further demands on the evaluation that we were going to make in order to measure the effects.

As a prior activity, a concept for the evaluation was sought after. It was important that the concept embraced the different complexities of the task. It should support the process of identifying and measuring the effects. The basis of the concept covered the goals and expectations set for the solution which quite naturally made the evaluation goal based (Krogstrup, 2003). Similarly, the evaluation was characterized as summative (Rossi, 1999; Friedman & Wyatt, 1997), as it focused on the goals which were set initially.

It was also considered as an important aspect to follow the implementation process in order to be able to explain the achieved effects – and even more importantly – to explain why expected effects did not occur. These aspects were embraced in what is known as process evaluation and were formative in nature (Rossi, 1999; Friedman & Wyatt, 1997) as they were open to all the conditions which influenced the effect variables formulated.

Evaluation models and concepts that embrace both the effects and the process exist. They are based on theory based evaluation, which focuses on the use of a so-called program theory. Such a theory helps explaining how the program in question can be transformed into specific results:

*[Program theory is] a plausible and sensible model of how a program is supposed to work* (Bickman, 1996).

Program theory is thereby included in what is known as 'Theory-based evaluation' (Bickman, 1987) and 'Realistic evaluation' (Pawson and Tilley, 1997). Both terms have been used as inspiration when creating the evaluation concept, and both make it possible to handle the effects as well as the process.

Our evaluation concept, which is based on the theory based evaluation, in respect of the Digital Hospital Project is presented below.

## **2. Theory-based Evaluation**

The main questions that are posed in theory-based evaluation regard whether we are able to confirm, deny or develop the program theory in order to improve the program continuously (Dahler-Larsen, 2003). The theory-based evaluation centers around seven steps or phases which are highly interrelated. These steps comprise:

1. Posing the evaluation question
2. Determining sources on which to base the program theory
3. Setting up the program theory
4. Making the program theory ready for evaluation
5. Choosing methods
6. Gathering data
7. Analysis and conclusion

These steps will be illustrated below with regard to the Digital Hospital Project. It will be emphasized how we conducted the evaluation within the frame of theory-based evaluation and how we included the more formative aspect, namely the implementation process, within this frame.

### **2.1 Posing the evaluation questions**

In this first step, focus is on investigating whether the program in question (in this case, the EPR system) has had an influence, in which way, and under which conditions. If the program consists of different components, the evaluation question will be divided into different sub-questions where each question relates to the specific component in the program.

The evaluation questions in relation to implementing the EPR system was outlined as statements in the project description under the heading ‘the purpose of evaluation’:

*Four desired effects of the Digital Hospital Project are formulated as:*

1. *The project ensures better patient information through providing relevant and comprehensible information on a convenient and user-friendly manner supported by digital tools.*

2. *The project creates a better hospitalization of the patient through a better and more effective organization and completion of examinations, patient treatment and care supported by digital tools.*
3. *The project enhances the quality in patient treatment and care, supported by digital tools, to create a better clinical basis for decisions and to enhance communication between healthcare professionals.*
4. *The project carries out a systematic collection of data concerning the influence of the digitalization regarding the operation of the hospital [...] with a view to demonstrating the possibilities for making the operation of the hospital more effective (DHP project description, page 6).*

The key aspects mentioned in the project description in relation to the evaluation question overall focused on: Better patient information, better hospitalization of the patient, enhancement of the quality in the patient treatment and care as well as making the operation of the hospital more effective. The majority of these areas centered on the patient. They were characterized by being rather abstract in nature and by a lack of detail. However, the overall goal was to evaluate the impact of the EPR implementation and the items listed above were further concretized when setting up the program theory (as described in section 2.3).

## **2.2 Determining sources on which to base the program theory**

When the overall question of evaluation has been defined, the program theory is to be initiated. Dahler-Larsen mentions a range of sources to be used with regard to this process (Dahler-Larsen, 2003). These comprise: Official political documents, statements from politicians, academic theory, evaluations, investigations and reports, professionals' experiences with the everyday practice, observations while the program is taking place, interviews with users, workshops where the program theory is established through dialogue, tasks and different creative techniques.

Not all types of sources are used every time the evaluator has to set up a program theory. In relation to the evaluation of the EPR implementation only a subset of the sources was drawn actively into the project.

First of all, the project description of the digital hospital project, mentioned above, can be considered as an official political document stating the objectives concerning the EPR implementation and concerning the evaluation. However, as it was also outlined above, the terms and the objectives in the project description were rather abstract in nature. In order to be more specific, we consulted different theoretical approaches on IT implementations and evaluation (Anderson, 1994; Friedman & Wyatt, 1997; Brender, 1997; Lorenzi & Riley, 1995; Svenningsen, 2002; Nøhr, Andersen et al., 2004; Kristensen & Nøhr, 2000). However, this did not help us in breaking down the objectives to more measurable indicators. We, therefore, searched for more concrete information as to EPR implementations in various Danish evaluation reports (Fischer & Lorenz, 1999; Udviklings- og uddannelsesafdelingen, Fyns Amt, 2001; Ankerhus, 2002; EPJ-observatoriet, 2000). The sources of information were used to determine the main areas to evaluate and the main indicators on which to base the evaluation measures.

A further useful source on which we have based our program theory is on the professionals' experiences with the everyday practice. In the initial phase of the evaluation process, representatives from each group of healthcare professionals – i.e. doctors, nurses, secretaries etc. – described their everyday clinical practice. In this way, we were able to highlight the areas in which there could be some expected effects of the EPR implementation.

This knowledge was combined with observation, both before and during the initial phase of the implementation. Dahler-Larsen (2003) argues that it sometimes can be difficult for the professionals clearly to express their work procedures vis-à-vis the evaluator. Systematic observations can help provide the program and its outcomes. We therefore observed different work procedures on the different wards where the evaluation was to take place – i.e. hospitalization of a patient, ward rounds, medicine procedures, the duties of the secretary group, staff education in EPR use etc.

In relation to the observation, it was critical for us to perform interviews with the users based on the observations as we did not have much background knowledge about the healthcare sector as a substantive domain. Focus group interviews were thereby arranged in order to highlight the areas where the main effects of the EPR implementation would emerge. The topic on these meetings was not related to the users' satisfaction or point of

view of the implementation. The aim was rather an extrapolation of the users' understanding concerning the outcomes of the implementation.

It is important in the initial phase of the evaluation to construct and set-up a concrete program theory. We experienced this process as highly relevant in order to indicate the effects of the EPR implementation and to obtain a comprehension of the clinical work procedures. This procedure will be outlined in the section below.

### 2.3 Setting up the program theory

When setting up the program theory, the effect variables which are focused on in connection with the evaluation are set up with the relations that are expected to be between the variables, and the relations express causality. The point of departure is based on 'the evaluation questions': Better patient information, better hospitalization of the patient, enhancement of quality in patient treatment and care and more effective hospital running, see the right hand side of figure 1.

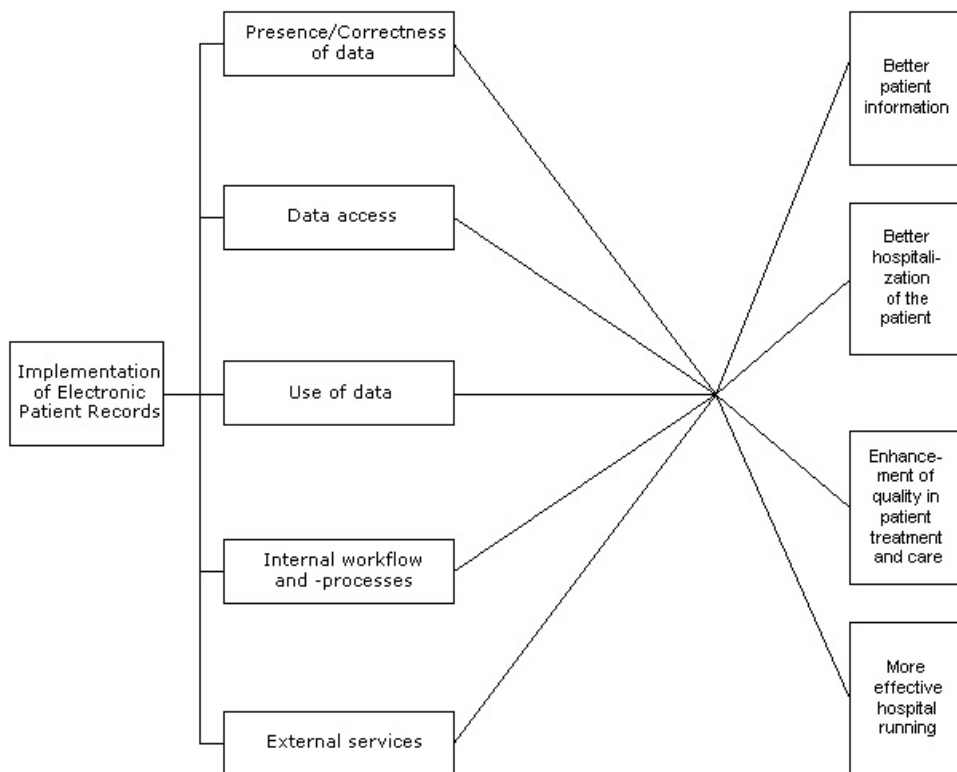


Figure 1: Program theory for the evaluation of EPR

These objectives cannot be translated into operational effect variables unambiguously. Through dialogue with stakeholders and by studying results from other evaluations the intervening effect variables are defined: Presence/correctness of data, data access, use of data, internal workflow and –processes, and external services, which are illustrated on the left hand side of figure 1. This results in a preliminary outline of the program theory for evaluating the EPR implementation.

There is causality between the intervening variables. However, we will not elaborate on this aspect as the actual evaluation primarily is aimed at answering the four evaluation questions. There are factors in the surrounding environment which influence the entire program. We call them processes or process factors. It might be factors such as managerial commitment, training and support, the suitability of the solution etc. These factors are conceived as moderators<sup>3</sup> (Dahler-Larsen, 2003). The negative moderators in our evaluation setup are noted and attempted validated by the implicated persons. Following this, an effort is supposed to be initiated by the project manager or other project members to help the implementation process back on track (the moderators will be elaborated on in section 2.4.2).

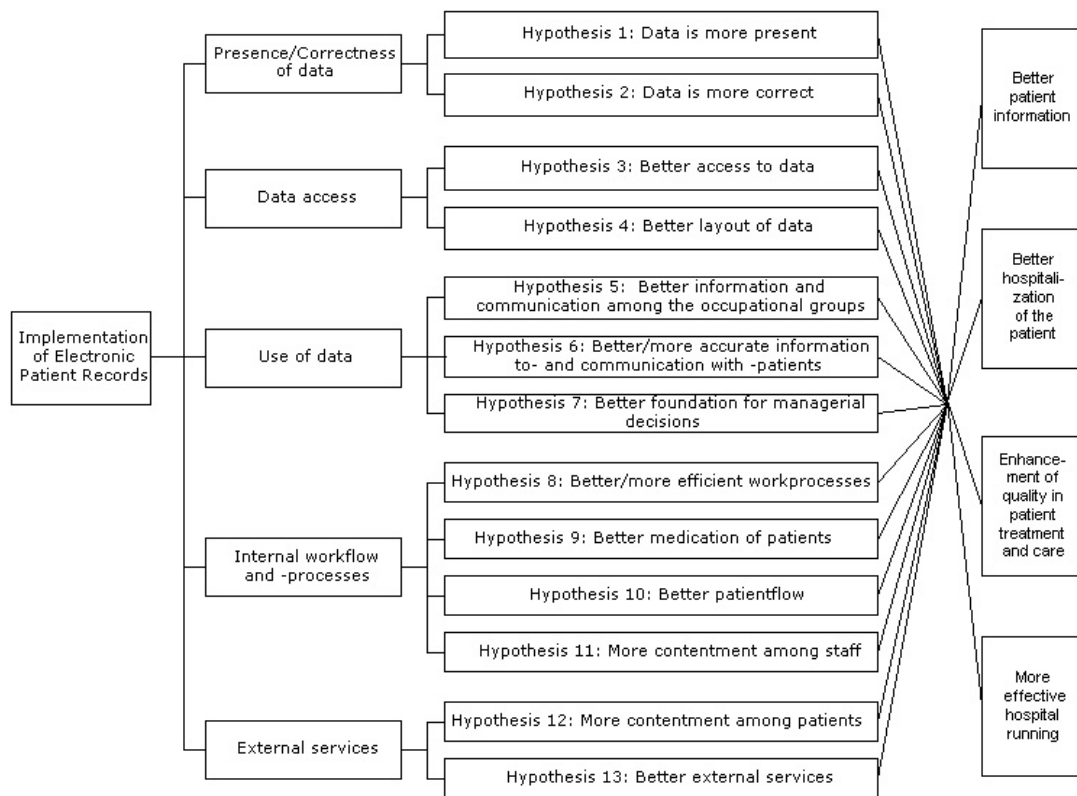
## **2.4 Making the program theory ready for evaluation**

In this phase, the program theory is defined in order to carry through the actual evaluation. With regard to our concept, the variables in the program theory are lacking a more precise definition before they are ready for use. We have managed this by incorporating the expectations vis-à-vis the EPR implementation in the variables. These expectations are formulated as hypotheses and part-hypotheses.

In figure 2 below, the program is illustrated with hypotheses attached to the part results. The part-hypotheses are not shown.

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<sup>3</sup> Moderators represent conditions that in a causality manner regulate another causality relation with regard to its strength and direction. For example, one can conclude that it is only persons with specific skin types or blood types that run the risk of mosquito bites. Or translated to a social political context, one can highlight that conversation therapy is only efficient for specific types of clients within a larger target group (Dahler-Larsen, 2003, p. 103-104)

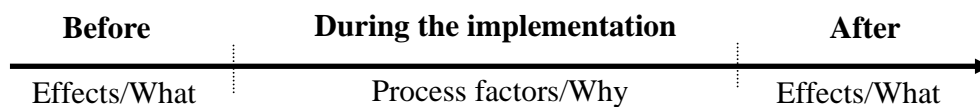


**Figure 2: Program theory for the EPR evaluation, including hypotheses**

The hypotheses are all relative. They state that something should improve, e.g. quality. These formulations are taken from the four evaluation questions which make demands on the evaluations that are to take place.

Ideally, several evaluations must be carried through over time in order to discover continuous improvements, but the evaluation at hand is based on only two measurement points – one before and one after the implementation.

In relation to this, our evaluation setup is based on three steps: “before”, “during” and “after” the EPR implementation as illustrated in figure 3.



**Figure 3: Setup – effect and process evaluation**

There is a time lag between the before and the after evaluation. In this time lag organizational changes might occur that have nothing to do with the EPR implementation, but still have an influence on the effects (the effect variables). It is important to be aware of such changes. It is also important to observe the actual implementation in order to identify circumstances in the process that might impede the implementation of the solution and thereby hinder the desired effects. As mentioned before these are process factors or, in evaluation terms, moderators (Dahler-Larsen, 2003).

#### **2.4.1 The effect evaluation – effects**

The effects are attached to the hypotheses as shown above in figure 2. The hypotheses are formulated in a relative manner. More evaluations are required in order to decide whether circumstances mentioned in the hypotheses have improved in quality and/or efficiency. We conducted evaluations twice, i.e. before and after the implementation.

The following four criteria have been crucial when defining each variable (effects/hypotheses) more precisely, and to ensure a valid connection with the goals for the implementation (Sundhedsstyrelsen: Den Danske Kvalitetsmodel for Sundhedsvæsenet - Modelbeskrivelse, 2004, page 9).

- Benefit: a substantial improvement potential should be present.
- Relevance: The effect should be of importance to a large group of people, e.g. patients, staff or to work processes.
- Resources: the use of resources in connection with defining the effects and gathering and processing the data should be reasonable and realistic.
- Measurability: the effect should be fairly easy to concretize in order to conduct the evaluation.

The use of the criteria above resulted in a set of indicators, upon which the effect evaluation was based.

## 2.4.2 The implementation process – moderators

As mentioned earlier, the EPR implementation process has been in focus – relating to the ‘during the implementation’ in figure 3 above – in order to identify the moderators (also called critical success factors) related to the implementation and to the effects. In relation to the project, we decided to focus on the factors that might impede a good process. For this purpose, a so-called Process Factor Matrix<sup>4</sup> (PFM) was developed as a tool to systematize and properly register the impeding factors. The catalogue-like structure of the PFM is illustrated in Figure 4 below, which shows the moderators.

Category	Factor
<b>People (Risk Factors)</b>	
<i>1. Education /knowledge</i>	1.a. Technical competence
	1.b. Attitudes towards the technology
	1.c. Courses
<i>2. Commitment</i>	2.a. Users’ commitment
	2.b. Implementers’ commitment to the objectives of the company
	2.c. Management’s commitment
<i>3. Strategies</i>	3.a. Strategy for user involvement
	3.b. Strategies for handling crises and conflicts
<b>Technology and System Development (Risk Factors)</b>	
<i>4. Preconditions</i>	4.a. Intention/ vision vis-à-vis the system
	4.b. Focus on variants
	4.c. Balanced focus
	4.d. Operation, maintenance and support
	4.e. Participation of the IT-department in the project
<i>5. System properties</i>	5.a. External resources
	5.b. System type
	5.c. Technological vulnerability
<b>Organization (Risk Factors)</b>	
<i>6. Focus</i>	6.a. Common vision on organizational learning
	6.b. The same focus
	6.c. The process for the project stands out clearly to all involved
	6.d. Interdisciplinary organization/involvement
<i>7. Change management</i>	7.a. Strategies for change management
	7.b. An organizational structure is established to support change
	7.c. A schedule is settled for user training
	7.d. Motivation strategies are developed
<i>8. Roles</i>	8.a. A structure for decision making is outlined
<i>9. Resources</i>	9.a. Resources in the project
	9.b. Prioritization of the resources
<b>People (Process Factors)</b>	

<sup>4</sup> For further reference see Andersen, P.E.R. and Kølsten de Wit, C., 2003.

10. <i>Role of project members</i>	10.a. Credibility of the project members
11. <i>The organizational management's competences</i>	11.a. Credibility of the management
	11.b. The ability of the management to communicate
12. <i>User management</i>	12.a. Involvement of users and partners
	12.b. User training in line with technological implementation
13. <i>Co-operation and communication</i>	13.a. Formal and informal co-operation
	13.b. A healthy project spirit
	13.c. Degradation of social conditions
14. <i>Project planning</i>	14.a. Establishment of a project schedule
<b>Technology and System Development (Process Factors)</b>	
15. <i>Analysis</i>	15.a. Analysis of work procedures
16. <i>Other technical aspects</i>	16.a. Rollout
	16.b. Methods for development
	16.c. Prioritization within the IT department
<b>Organization (Process Factors)</b>	
17. <i>Organizational development</i>	17.a. Management of the organizational development
	17.b. Transition from manual to electronic work procedures
18. <i>Manning</i>	17.c. Allocation of resources
	18.b. Recruitment
19. <i>Interfaces</i>	19.a. Interfaces between parties
	19.b. Interfaces between phases in the project
20. <i>Expectations</i>	20.a. Realistic expectations

**Figure 4: The structure of the Process Factor Matrix (moderators)**

As Figure 4 shows, the PFM is structured on the basis of both risks and project factors. These areas are divided into three main groups: People, Technology and System Development and Organization. Each of the three groups contains a number of factors which affect the implementation process (cf. figure 4). Each factor equally contains five process indicators on average – these are not shown in figure 4. This makes the PFM rather extensive, and thereby complicated in its use (for further elaboration, cf. section 3.2 on implications).

There are several reasons for focusing on the implementation process. First of all, it is important for evaluators to be able to provide an explanation as to why expected effects have been achieved – or perhaps more importantly, why certain effects have *not* been achieved. If the expectations and the goals for implementing the EPR system have not been fulfilled, it will be natural for the steering committee or the project owner to ask the evaluator why this is the case. Therefore the collection of moderators is crucial to provide answers to effects – or lack thereof – and thereby to learn from the implementation process.

In that sense, there is a learning perspective integrated in using the PFM and on focusing on the implementation process. That is, how can we better manage implementation processes and what can be considered critical aspects when implementing EPR systems within the healthcare sector. The PFM and how we focused on the implementation process will be elaborated on in section 2.5.2 below.

## 2.5 Choosing methods

A wide range of methods were used to gather data for the subsequent analyses of the program theory: Questionnaires for the patients and the staff, observations, focus group interviews, work flow descriptions etc. The concrete planning of the use of methods has been piloted by the four criteria set above: Benefit, relevance, resources, and measurability. Especially the measurability has been a challenge. Some of the effects have not been easy to translate into measurable indicators, which have resulted in a planning with doubling or triangulation of the use of methods, e.g. interviews and observations have been used as a supplement to the data that has also been retrieved through questionnaires.

### 2.5.1 Methods – the effect evaluation

When it comes to the effect evaluation, different methods for data gathering and analysis have been used. Below is a brief description of the methods and their relation to the hypotheses listed in relation to the program theory in figure 2:

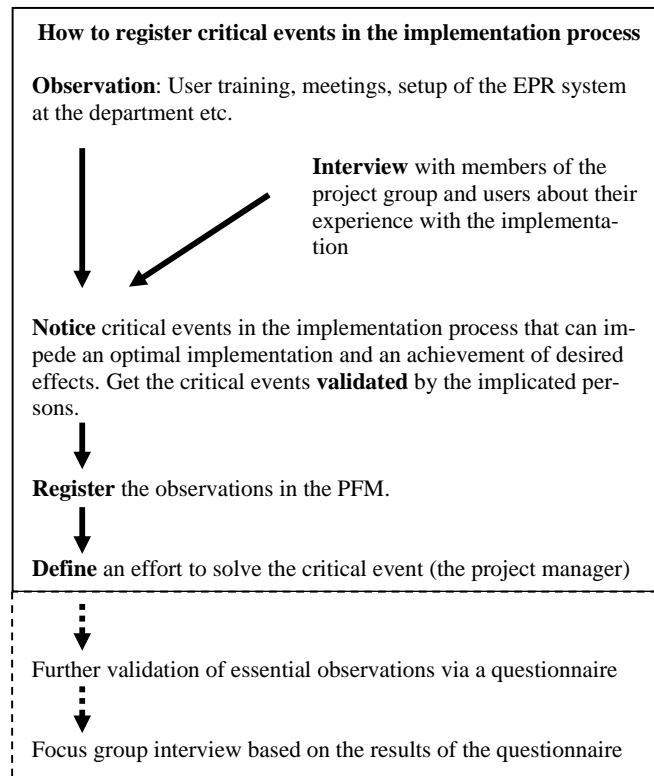
- **Observations and interviews:** have been used to obtain an understanding of the work processes at the hospital, e.g. the fill in of journals, ward rounds, medication processes etc., which in turn led to obtaining a picture of the hospital and the culture. Furthermore, the methods have been used to identify the expectations and goals of the users with regard to the EPR solution. Observation and interviews were used before, during and after the implementation process.
- **Descriptions of the work flows:** have been useful in understanding the work flows at the wards involved in the evaluation, i.e. both the work flows before the evaluation, the expectations to the future work flows and how they have turned out to be after the implementation of EPR. The descriptions were also useful

when identifying the effects and in formulating hypotheses for the work processes, which covered hypotheses 1 through 11. The work flow descriptions have been carried out before the implementation as well as after.

- **Journal audit:** has been used to examine the quality of the clinical documentation undertaken before and after the EPR implementation – i.e. documentation in the paper record and in the electronic record. The audit has been used in relation to hypotheses 1 and 2, as well as 8 through 11, and an audit has been carried out before the implementation as well as after.
- **Staff questionnaires:** have been used to examine the presence/correctness of data, data access, use of data and internal workflow and -processes. The staff has furthermore evaluated different circumstances as expectations towards the solution and their experience of the implementation process. The questionnaire has been used in relation to hypotheses 1 through 11, and staff questionnaires have been distributed before as well as after the implementation.
- **Patient questionnaires:** have been used to examine the patient perceived quality on information and communication, the hospitalization flow, and general contentment. The patients have answered questions based on their experiences when it comes to information and communication before and after the introduction of the EPR. The questionnaire has been used in relation to hypotheses 6 and 12, and patient questionnaires were distributed before the implementation as well as after.
- **Focus group interviews:** have been conducted mainly in the final process in order to clarify, elaborate and comment on the effects measured. Circumstances regarding the implementation process were also a topic in the interviews. The focus group interview was related to hypotheses 1 through 11, and a focus group interview was carried out as the final study of the effects and the implementation process.

### 2.5.2 Methods – the implementation process

Similarly, a range of methods were used in order to focus on the implementation process. Some of the methods are described in figure 5 below:



**Figure 5: Registration of critical events in the implementation process**

As illustrated in figure 5, the implementation process was closely followed by the evaluators in order to observe if any critical events appeared. Observations at meetings, at user training sessions, and at the ward were accomplished as well as conducting interviews with clinicians in the final stage of the implementation process. These interviews were also performed as an aspect of the learning perspective – i.e. how to improve future implementation processes based on the gained experiences. Furthermore, as the dotted line in figure 5 shows, an add-on was made to this observation guide. In order to sum up the observations that were made during the implementation process, central observations were grouped and placed in a questionnaire which was distributed among the staff for further validation. Based on the results of the questionnaire, a focus group interview with staff was held in order to extract reasons for implementation process results and learning for implementation processes to come.

## **2.6 Gathering data**

A considerable amount of resources were spent on data retrieval in connection to the effect evaluation as well as the implementation process. In more cases, the observations and interviews have been repeated to ensure that important factors have not been missed. It also turned out that some of the methods chosen in a given context had to be cut out or supplemented with other methods as the validity of the results could be questioned.

### **2.6.1 Gathering data – the effect evaluation**

Collection of data on the effect side was based on a variety of methods. The initiating maneuvers, which were carried out before the implementation started, consisted of the description of work flows, followed by the distribution of questionnaires, a study of documentary data and journal audits. When the implementation process was accomplished and the use of EPR was stabilized at the hospital, all of the above mentioned methods were carried out again, according to the ‘before’ – ‘after’ setup.

Along with this, the process was observed before, during and after the implementation, which will be elaborated on in the following section.

The very last evaluation study of the EPR implementation was a focus group interview, which centered on a clarification and a commenting of the results gathered by the above mentioned methods.

A further comment on the methods used is that a high proportion of the hypotheses were examined by the use of questionnaires directed to the staff and the patients, where the other methods were used to a lesser extend. The questionnaire approach was used extensively as a result of the need for quantitative data and the prioritizing of the evaluation project resources.

## 2.6.2 Gathering data – the implementation process

The main part of the data collection when it comes to the implementation process was accomplished via observations, i.e. via meetings, user training sessions, and in daily work situations – as indicated in figure 5 above. However, it turned out that observations were not enough to collect data on the obstacles in the implementation process. The method had to be supplemented. We managed this by adding supplementary questions to the staff questionnaires regarding the process and by adding this as a topic in the final focus group interview.

## 2.7 Analysis and conclusion

The conclusion of a theory-based evaluation focuses on the effects and thereby on the program stated (Dahler-Larsen, 2003). The main concern is whether the results in the program theory have been obtained or not? Naturally, intermediate forms between 0% and 100% fulfillment might be gained. The next question concerns whether the effort has been implemented correctly or not. This combined with the two possibilities in respect of fulfillment of the effect side results in four combinations (Dahler-Larsen, 2003). We will not elaborate on these combinations here but just comment on the placement of this evaluation project within these combinations later in this section.

### 2.7.1 Analysis and conclusion – the effect evaluation

In figure 6 below, the thirteen hypotheses regarding the effects are listed. For each of these it is concluded whether the hypothesis is accepted, inconclusive or rejected.

	Data indicates the hypothesis is accepted	Data regarding the hypothesis is inconclusive	Data indicates the hypothesis is rejected
<b>Presence/Correctness of data</b>			
Hypothesis 1: Data is more present	X		
Hypothesis 2: Data is more correct		X	
<b>Data access</b>			
Hypothesis 3: Better access to data	X		
Hypothesis 4: Better layout of data			X

<b>Use of data</b>			
Hypothesis 5: Better information and communication among the occupational groups			<b>X</b>
Hypothesis 6: Better/more accurate information to- and communication with – patients			<b>X</b>
Hypothesis 7: Better foundation for managerial decisions			<b>X</b>
<b>Internal workflow and –processes</b>			
Hypothesis 8: Better/more efficient work processes			<b>X</b>
Hypothesis 9: Better medication of patients		<b>X</b>	
Hypothesis 10: Better patient flow			<b>X</b>
Hypothesis 11: More contentment among staff		<b>X</b>	
<b>External services</b>			
Hypothesis 12: More contentment among patients			<b>X</b>
Hypothesis 13: Better external services	<b>X</b>		

**Figure 6: Conclusions regarding the program theory’s hypotheses**

As figure 6 shows, approximately 23% of the hypotheses are accepted, an equal part is inconclusive, and the remaining 54% are rejected. This statement is based on each hypothesis and the matching part-hypotheses.

In this aspect it is noteworthy that two of the accepted hypotheses are directed at the data dimension: “Data is more present” and “Better access to data”, which have no direct user dimension. The subsequent hypotheses, which are more directed at supporting the daily assignments, are not among those that are accepted or inconclusive. Furthermore, it should be added that the hypothesis with a patient angle, hypothesis 12: “More contentment among patients”, is rejected. This is an important aspect compared to the four overall evaluation questions, as illustrated in figure 1 and 2 earlier.

### **2.7.2 Analysis and conclusion – the implementation process**

As mentioned, the EPR implementation process played a central part in the evaluation setup. The contents of registrations in the PFM were summed up in a group of essential

questions which were posed to the staff along with the post implementation questions. Below, the results of these questions concerning the process are outlined.

	Highly Satisfactory	Acceptable	Unsatisfactory
<b>Questions</b>			
The formulation of project objectives			X
The EPR system is stable in operation	X		
The EPR user training		X	
EPR possibilities meets the users' expectations		X	
EPR user adjustment according to users' needs			X
Head of the department backs up the process	X		
Resources allocated for subsequent operation and support		X	
Resources allocated to exempt the staff from their normal duties in order to attend user training, meetings etc.			X

**Figure 7: Questions from the PFM, regarding the implementation process**

In figure 7, the eight questions regarding the process are listed. For each of these it is concluded whether the staff is highly satisfied, accepting or unsatisfied with this aspect of the implementation. Approximately 25% of the questions regarding the process show a high degree of satisfaction among the staff, approximately 37% show an acceptable level and an equal part show dissatisfaction regarding the process.

These aspects form a clear picture of the implementation process seen from the users' point of view. In relation to that, it should be mentioned that the nurses and the secretaries have been the two groups the most favorably disposed when it comes to the process, whereas the group of doctors has been more negative.

To follow up on the users' experiences of the implementation process, a focus group interview was held where the above questions were discussed. Furthermore, the healthcare professionals provided recommendations for future EPR implementation processes. The main contribution from the staff, apart from the above mentioned areas, was:

- It is favorable with small wins during the implementation

- Project champions are to be spotted (it is important to spot someone who is enthusiastic vis-à-vis the implementation)

Along with the results from the questionnaire, this provides important indications as to why the effects turned out the way they did. Furthermore, it provides important focal points for implementation processes to come.

On the basis of the results from both the effect and process evaluation, it can be concluded that the effects visualized in the program theory in figure 2 are not realized to a further extent than approximately 23% of the expected returns. As for the moderators, the rate is approximately the same. When neither the implementation process nor the occurrence of results is redeemed, we end up with a possibility of either implementation- or theory failure. Therefore, it is difficult to conclude further on these results. The lack of effects might stem from a flawed program theory, the influence of moderators or a flawed implementation, but we have no way of making any valid conclusions about it.

### **3. Implications**

As mentioned in the introduction, it is essential to take into consideration both the effects and the process when it comes to an EPR implementation. This is the reason why we emphasized the process angle within the frame of program theory when evaluating the EPR implementation. Furthermore, we intended to use the PFM to explain some of the results, thereby validating, enhancing or renewing the program theory. However, there are both advantages and disadvantages in using this setup, which will be elaborated on in the sections below.

#### **3.1 Implications – the effect evaluation**

Contingent on the implementation process being followed through successfully, it will be possible to enhance and adjust the program theory further. The causality between the EPR implementation and the effects should be extended in order to deal with the remaining ‘black box’ issue of the causal relations in the program theory. An enhanced program theory would give the opportunity, in time, to attempt to generalize the program theory (Dahler-Larsen, 2003). Thereby, it is possible to share the knowledge and experiences from this implementation and put this to use in other EPR implementations at other hospitals.

With regard to the aspect mentioned above, a two-year project has been initiated by the authors in 2004. The aim of this project, termed ‘Effect Model Development’, is to establish a catalogue containing a common set of indicators concerning the effect evaluation of EPR implementations. The set of indicators are developed in cooperation with practitioners from different county hospitals, which will ensure the validity of the indicators across the counties. With a common set of effect indicators, the purpose is to be able to compare the effects obtained from EPR implementations at different hospitals in Denmark and thereby build on benchmark initiatives. Furthermore, the purpose of the project is to nominate different performance quality measures in relation to EPR implementations across Danish hospitals.

### **3.2 Implications – the implementation process**

As mentioned in the introduction, special emphasis was put on the implementation process in relation to the effects. This is a highly relevant aspect in relation to the program theory in order to conclude on the findings and to determine whether the program is correctly implemented – as mentioned by Dahler-Larsen (2003). The PFM was developed in order to identify critical events in relation to the implementation process. The main reason for focusing on the process factors was to be able to provide an explanation as to why expected effects had been achieved and why certain effects had not occurred. In relation to this, the PFM helped providing a rather systematized data collection and it facilitated a learning perspective, i.e. what can be considered as critical aspects when implementing EPR systems within the healthcare sector. The PFM provides the evaluator and the project manager with a list of events that are critical in order to achieve the intended effects. This knowledge is considered important both in the initial phase of the implementation and during the implementation as it allows the project manager to intervene if critical factors that can impede an optimal effect have been registered.

Having used the PFM in relation to the Digital Hospital project, however, indicates some difficulties. First of all, the matrix appears to be too comprehensive by listing up too many critical events and indicators as to these events. On the other hand, it sets a frame than can be too limited – e.g. how do we take into account an event that does not ‘fit’ or that does not seem to be integrated into the framework of the PFM? More importantly, we experienced the difficulty in providing clear answers as to which factors in the implementation process that directly related to a specific effect.

In relation to this, one of the authors has initiated a PhD project focusing on the determination of critical events in the EPR implementation process (Jensen, 2005). This research is to provide a more in-depth understanding of the EPR implementation process by identifying and analyzing the most central means and ends in the implementation process from the health care professionals’ point of view – i.e. the most central activities in the implementation process, their consequences, and the values of the health care professionals. The PhD project was initiated in April 2004 and runs on a three-year basis. Eventually, the intention is to integrate the implementation project findings from the PhD project with the effect evaluation in order to set up a comprehensive program theory.

#### **4. Conclusion**

The purpose of this paper has been to present the theory based evaluation as a frame for evaluating the implementation of an EPR within the Danish healthcare sector. Emphasis has been made on how to conduct an evaluation which takes into consideration both the effects and the process. Hereby, we have provided a frame for evaluators and other practitioners on how to tailor and conduct evaluations in order to determine the value of an IT implementation in the healthcare sector.

The use of theory based evaluation as a frame for evaluating the EPR implementation at Vendsyssel Hospital in Frederikshavn has indicated both some advantages and limitations. An advantage by using the theory based evaluation is related to the linkage of the effects and the moderators. This link provides the opportunity to support the effects with some explanations – i.e. to systemize the learning in relation to an effective EPR implementation.

One limitation in using the theory based evaluation setup is that the program theory cannot be validated unless the effort, here the EPR implementation, is carried through successfully. Therefore, it is problematic to base the entire evaluation on program theory because there is a risk that the evaluation setup cannot be validated – which turned out to be the case in this EPR implementation.

Further research is needed in relation to the effects and the process (the moderators):

- One contribution is to point out realistic effects that are to be obtained when implementing EPRs within the healthcare sector. The causality across the effects is to be outlined in a more formalized manner. This work has already been initiated in cooperation with several Danish counties that are implementing EPRs at present.
- Another contribution, related to the aspects mentioned above, is to obtain a more in-depth understanding of the process (the moderators) that is related to the effects. This is accomplished in relation to a PhD project which identifies the most central activities and consequences in an EPR implementation process.

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