

# CRITICAL AREAS OF NATIONAL ELECTRONIC HEALTH RECORD PROGRAMS - IS OUR FOCUS CORRECT?

Eva Deutsch<sup>1,2</sup>, Georg Duftschmid<sup>1</sup>, Wolfgang Dorda<sup>1</sup>

<sup>1</sup> Core Unit for Medical Statistics and Informatics,  
Medical University of Vienna

<sup>2</sup> IBM Global Business Services Healthcare

Corresponding author: Georg Duftschmid  
Core Unit for Medical Statistics and Informatics, Medical University of Vienna,  
Spitalgasse 23, 1090 Vienna, Austria  
Phone ++43 1 40400 6696  
georg.duftschmid@meduniwien.ac.at

Keywords (MeSH): Medical Records; Medical Records Systems, Computerized;  
National Health Programs

NOTICE: this is the author's version of a work that was accepted for publication in International Journal of Medical Informatics. Changes resulting from the publishing process, such as peer review, editing, corrections, structural formatting, and other quality control mechanisms may not be reflected in this document. Changes may have been made to this work since it was submitted for publication. A definitive version was subsequently published in

*E. Deutsch, et al., Critical areas of national electronic health record programs—Is our focus correct? Int. J. Med. Inform. (2010), doi:10.1016/j.ijmedinf.2009.12.002*

# Abstract

Objective: National electronic health record programs are frequently associated with a number of problems. In view of their long duration and costs, efficient implementation of the programs with due regard given to the conclusions drawn thus far would be a meaningful goal from the economic point of view. In the present report we analyze programs from various countries with regard to the problems documented therein and derive, on a cross-country basis, the most common critical aspects of national electronic health record programs. These aspects should be given special attention in the implementation of future national electronic health record programs. Furthermore, measures which have proven to be useful in coping with the respective problems in individual countries will be suggested for each critical area.

Method: Five countries were selected in which (a) programs for a national electronic health record system exist since at least five years, (b) the planned electronic health record systems encompass various approaches of implementation, and (c) pilot projects have already been conducted. The programs of these countries were analyzed on the basis of project reviews and audits with reference to the problems documented during their implementation. These were abstracted and standardized into cross-country categories which, in turn, were grouped into critical areas.

Results: From the analysis of national electronic health record programs from England, Germany, Canada, Denmark and Australia, the following frequently involved critical areas were derived: (a) Acceptance and change management, (b) Demonstration of benefits and Funding, (c) Project management, (d) Health-policy-related goals and implementation strategy, (e) Basic legal requirements, particularly in the field of data protection.

Conclusions: The analysis shows that similar critical areas exist in the various countries. Strategic, organizational and human challenges are usually more difficult to master than technical aspects. The measures used thus far to deal with the critical areas are selective approaches towards resolving individual problems. For the future it would be desirable to set up a comprehensive method that provides support in the complete process of implementing national electronic health record programs and hereby covers all critical areas identified within this paper.

# 1 Introduction

Throughout the world, national electronic health record (EHR) implementations<sup>1</sup> are regarded as an opportunity to effect a fundamental improvement in the public health sector [2,3,4]. However, EHR programs are complex projects spanning periods of several years and involving high investments. In addition to the establishment of an integrated information technology (IT) landscape the programs require accompanying measures such as coordinated goals in health care policy, alignment with health care system in sectors such as finance, law or promotion of cooperation, and the creation of a climate of change in order to implement the necessary clinical organization and cultural changes for every service provider and citizen.

Currently the majority of countries is in an early planning phase of an EHR program or is implementing sub-areas. A few forerunners have already gained several years of extensive experience [3,5]. Initial experience concerning these projects demonstrates the complexity of national EHR implementations, revealing problems such as slow progress of the projects [6], discussions concerning the implementation strategy [7,8],

---

<sup>1</sup> According to ISO TR 20514 [1] a (basic-generic) EHR is defined as a repository of information regarding the health status of a subject of care, in computer processable form. Further, a Shared-EHR system is defined as a system for recording, retrieving, and manipulating information in EHRs that is built to facilitate integrated shared care within a "community of care". Considering the terminology of TR 20514 this paper is concerned with implementations of nationwide Shared-EHR systems for managing the information in EHRs of a country's citizens. For reasons of simplicity and in analogy to common parlance in literature we will use the phrase "national EHR implementations or programs" in the following.

resistance or poor acceptance in the medical community [9,10] or questioning the large investments and/or their prioritization [9,11]. Considering these reported problems one may conclude that the before-mentioned non-technical accompanying measures required in the context of EHR programs were not being executed in adequate measure. Interestingly, when comparing different national EHR projects we can observe that there even exist a number of “standard pitfalls” which are commonly encountered and which we will report on in section 4. Given the long duration and significant costs of national EHR programs, efficient implementation with due consideration given to the conclusions drawn from previous implementations would be of significant economic interest.

In the existing published scientific literature there are currently no comparisons of approaches of implementation or cross-country analyses of the problems associated with national EHR implementations. The aim of the present study is to analyze national EHR programs of different countries and identify the problems reported therein. The detailed problems will then be abstracted for the purpose of cross-country comparability, and grouped into "critical areas" which will then be arranged according to the frequency of the underlying detailed problems. Furthermore, various documented measures in the individual countries will be discussed. These measures proved to be useful in coping with sub-aspects of the critical areas of national EHR implementations.

## 2 Related work

The **Gartner group** published two reports [12,13] which mention the following as critical factors of the success of regional and national EHR projects: (1) demonstration of the health-policy strategy and its benefit, (2) project planning and governance, and (3)

management of the relationship between the stakeholder and the supplier. Comprehension of these publications is limited by the fact that the authors neither mention the sources on which the postulated factors of success are based nor describe the procedure by which these were derived from the sources. The completeness of their account of critical factors of success may also be questioned.

In the course of the **eHealth Impact Study** Stroetmann et al. [14] analyzed the key factors and conclusions of ten European eHealth projects. The contents of the projects range from purely informative services to health card projects, applications such as the ePrescription, and two national EHR projects in the Czech Republic and Denmark. The following were identified as key factors of the various projects: (1) commitment and involvement of all stakeholders, (2) a strong health policy and clinical management, (3) regular analysis of costs, incentive systems and benefits, (4) organizational changes in the clinical and work sector, (5) good organizational change management, interdisciplinary teams with IT experience and clear incentives, and (6) clear long-term perspectives, endurance, and patience. As only 20% of the investigated eHealth projects were national EHR implementations, the key factors determined are of limited informative value in our context.

In a survey conducted by the **Medical Records Institute** [15] the following were determined as the principal barriers to EHR implementations (1) low budget / poor resources, (2) too little support from the medical community, (3) high costs of EHR systems, (4) difficulty to evaluate appropriate EHR solutions or components, (5) finding an EHR solution that fulfils one's own requirements, (6) the emergence of fragmented solutions, (7) the change from paper-based to electronic files, and (8) the creation of a strong Business Case (ROI). The barriers determined in a survey comprising 568 par-

ticipants refer to Local-EHR systems<sup>2</sup> of a few health service providers; it is doubtful whether these conclusions can be extrapolated to national EHR programs.

**Brender** et al. [16] analyzed factors of success and error in health information systems for various applications, including clinical systems. The latter, according to the authors, encompass Local-EHR systems. The authors determined 110 factors of success and 27 error factors. The factors were evaluated by experts in a Delphi study. The large number demonstrates the complexity of the subject and also the different factors that exert an impact and determine the final outcome of the implementation. According to Brender et al., important factors of success and error include the following: (1) aligning functionality with user requirements and work processes, (2) willingness to change, intensive communication, training of and cooperation between IT and other persons involved, (3) understanding the culture of the health sector and an evolutionary approach, (4) commitment at the highest level and coordination of IT/business strategies, (5) project management, (6) high usability and interoperability or integration based on standards, (7) taking basic legal requirements into account, and (8) adequate cost-effectiveness, benefits, and funding. Brender et al. also refer to other analyses and point out to the fact that particularly the organizational environment creates challenges and barriers for IT solutions. Therefore, strong predictions about successful implementations have primarily been made in the areas of organization and individuals, behavior, management and communication, implementation process and change management, and less so in respect of technology. The informative value of Brender et al.'s analysis

---

<sup>2</sup> According to [1] a Local-EHR system is defined as a system for recording, retrieving, and manipulating information in EHRs that is usually only accessible to authorized health professionals within a particular health organization. It contains detailed locally acquired health data as well as externally sourced material.

for national EHR implementations is questionable.

**Protti** et al. [17] compare the status of primary care physician office computing in Andalucía to that of Denmark by contrasting the functionality of Local-EHR systems<sup>3</sup> and the ability to electronically communicate clinical information in both jurisdictions. The identification of critical areas for the computerization of general practitioners (GPs) is not a particular goal of the study. Nevertheless, it is stated that (1) financial incentives for GPs, (2) saving of time for GPs and patients through automation, (3) demands of different age/gender groups on the health care system, and (4) improved possibilities for information management, decision support and research were reported as boosting factors. Although the exchange of clinical information between GPs is examined to some extent their primary focus lies on the functionality of the GPs' Local-EHR systems. In contrast to them we are primarily interested in critical areas of national EHR programs and their underlying Shared-EHR systems.

**Blumenthal** [18] discusses the role of the federal government in the US in pushing the adoption of health information technology (HIT). He identifies obstacles and implementation suggestions that federal policymakers are confronted with in promoting the use of HIT systems and the interoperability between these systems. Blumenthal concludes that in order to achieve a high level of HIT adoption, the federal government should (1) provide financial support for purchasing and implementing HIT systems, (2) provide financial support for information exchange in local communities, (3) support research and development designed to improve the capabilities of HIT, (4) focus attention on the contribution of HIT to improve the health system in general, and (5) create national

---

<sup>3</sup> The authors use the notion electronic medical record (EMR) and examine systems that manage EMRs. They refer to a definition that stresses the intra-organizational scope of EMRs. According to this definition an EMR system correlates with the notion of a Local-EHR system as defined in [1].



standards and regulations to improve the physicians' confidence in the electronic management of health information. In general, the recommendations made seem to primarily originate from observations of the situation of the US health system. Further, the article mostly focuses on the principal adoption of basic HIT components such as Local-EHR systems.

The literature published thus far does not offer the aspired cross-country analysis of critical areas of national EHR programs. The analyses are either focused on Local-EHR systems [15,16,17,18] or summarize different types of eHealth projects [14]. Only [12,13] identify a choice of critical factors of success in national EHR implementations. It is not clear, however, how this selection of factors of success was made in the latter two reports, on what basis they were determined, and whether additional factors of success exist.

### 3 Method

Critical areas of national EHR programs were identified on the basis of the following activities:

1. In the first step, the countries whose EHR programs were supposed to serve as the source of identifying critical areas were selected. The countries included in the analysis were chosen on the basis of the following selection criteria: a program for a national EHR system had been in existence for at least five years, at least several pilot projects had been implemented, various approaches of implementation had been covered and, in addition to sufficient information in English or German, reviews of the status and success of the projects had been conducted. In order to achieve wide geographical coverage, countries from var-

ious continents were analyzed. Thus, England, Germany, Denmark, Canada and Australia were selected.

2. In the next step, the national EHR programs of the named countries were analyzed in respect of the problems documented during their execution. The primary sources of the analysis were project reviews and audits:
  - Several externally commissioned consulting projects were conducted in England [19], Canada [11,20], Denmark [21] and Australia [6,22]. In the course of these projects, either the overall national EHR project or the EHR coordination office was analyzed and rated with reference to its achievement of goals and its strengths and weaknesses.
  - Published problematic areas and "lessons learned" as well as specific nation-wide studies in England [8,23,24], Germany [9,10,25,26,27,28,29,30,31], Denmark [32,33,34,35] and Australia [36]
  - Public audit reports in England [51,52]
3. The detailed problems were abstracted as far as possible, for the purpose of summarizing them into categories on a cross-country basis.
4. Categories related to each other in terms of content were grouped into critical areas. The critical areas were then arranged according to the frequency of the underlying detailed problems.

## 4 Results

In principle it was found that the countries included in the analysis were in different stages of their EHR implementation. Germany [37,38,39,40,41,42,43,44,45,46] is implementing the first pilot projects for the electronic health card with basic applications; Australia [36,47,48,49,50] has implemented small regional EHR pilot projects with real

data in several territories. England [6,51,52,53,54] is in an early general stage of EHR implementation but has already achieved extensive implementation of individual eHealth applications in the course of regular operation. Canada [20,55,56,57] plans to cover 47% of its population with a national EHR system by the year 2010. Denmark plays a leading role in the interconnectivity of GPs Local-EHR systems with hospitals, pharmacies and specialists [17]. About 98% of the doctors, 100% of the hospitals and all pharmacies are already networked [32,33,58,59,60], and a nation-wide EHR system has been implemented.

Table I shows a selection of contextual measures that provide a coarse overview of the preconditions for national EHR programs in the five countries. It offers some indication of the maturity of the individual national EHR efforts which may be contrasted with the corresponding documented problems (see section 4.1) and the derived critical areas (see section 4.2).

<b>Preconditions for national EHR programs</b>	<b>GB</b>	<b>DE</b>	<b>CA</b>	<b>DK</b>	<b>AU</b>
GPs using Local-EHR systems (in %)	95 [61] <sup>4</sup>	92,5 [61] <sup>4</sup>	23 [62] <sup>5</sup>	96,9 [61] <sup>4</sup>	79 [62] <sup>5</sup>
GP practices electronically transferring patient data (in %)	91 [61]	66 [61]	n.a.	98 [61]	n.a.
Estimated per-capita costs of national EHR program (in €)	233 [63]	17 [37]	209 [64]	97 [65]	75 to 108 [66]

Table I – Selection of contextual measures providing a coarse overview of the dimensions of national EHR programs in England (GB), Germany (DE), Canada (CA), Denmark (DK), and Australia (AU).

---

<sup>4</sup> Data from 2007, Survey reports percentage of GPs that store individual patient data in a practice's computer system.

<sup>5</sup> Data from 2006

## 4.1 Documented problems of national EHR programs

In this section we focus in detail on the national EHR programs of the five countries included in the analysis. After a short overview of their programs the problems encountered therein, as reported in the above mentioned project reviews and audits, are presented in detail.

### 4.1.1 England

The EHR program is part of the national healthcare reform and was initiated by the ministry of health [52]. The primary goal is to improve patient care. In October 2002 the *National Programme for Information Technology (NPfIT)* was founded, in April 2005 all IT related activities were concentrated in the organization *NHS Connecting for Health*. The implementation is planned to be completed until 2010. A status report from 2007 [54] showed that 80% of the planned scheduling component was implemented, 20% of the medication component and 30% of the national EHR system.

#### Documented problems of the national EHR program

The audit report of the National Audit Office [51] mentions the following problems of the NPfIT: (a) difficulties in adhering to project plans and schedules, (b) challenging the alignment of the implemented systems to NHS requirements, (c) difficulties in taking over tasks and responsibilities on the part of the respective NHS organization responsible for local implementation of the systems, (d) difficulty in gaining the acceptance and support of NHS staff and the public, (e) challenging the vision of the program and the implementation strategy, (f) no presentation of the cost-benefit ratio of the national

program, (g) underestimation of the local need for process optimization and poor integration of clinicians into the project, (h) enforced replacement of the existing hospital information systems, (i) questioning confidentiality and security, and (j) implementation of the purchase process and product decisions.

The project status of the NPfIT is analyzed in [52]. The following points of criticism are raised: (a) the project schedule has already been delayed by 2 years, (b) doctors have not been sufficiently convinced of the project, (c) clinicians have not been adequately integrated into the project, (d) no cost-benefit analysis has been performed, (e) the total costs have not been determined and no monitoring of the achievement of goals exist, (f) bottlenecks in terms of resources, (g) the program management is excessively focused on technical aspects and too little attention is given to the organizational change process, (h) responsibilities for local implementation are not clearly defined, (i) selection options for applications are too few or non-existent, (j) the requirement analysis and alignment to actual NHS requirements is not easily comprehensible, and (k) doctors are skeptical about data safety.

The deficiencies of NPfIT are delineated in [24]: (a) incomplete specification at the time of assignment, (b) financial instability of a few key suppliers because of delays in supply, (c) the risk of late determination of data protection and data safety regulations accompanying the implementation, (d) the small number of well trained healthcare IT resources and their insufficient experience in dealing with large IT projects, (e) poor or delayed integration of clinicians, which may give rise to far-reaching additional costs, and (f) negative impact on acceptance due to the "opt out" model (according to this model the patient must explicitly state his non-acceptance of any undesired data transfer).

Brennan was in charge of the project for electronic medical files in the NHS from 1996

to 1999 and states the following principal problems of the NPfIT program in [8]: (a) resistance to the enforced replacement of existing IT solutions, and (b) what he considers inappropriate focus on the national networked solution instead of giving priority to local implementations as the first step.

The following additional sources of problems have been mentioned by Edwards from the Gartner group [7]: (a) few or no selection options for applications, and (b) prioritization of local co-funding for important sub-areas.

A survey among doctors conducted by Medix in 2006 [23] revealed that doctors' confidence in the successful implementation of the program was significantly declining in the course of the project. In a survey conducted in 2003, 56% of practicing doctors and 75% of hospital doctors were enthusiastic about the program; three years later the corresponding figures were no more than 25% and 41%, respectively.

#### 4.1.2 Germany

eHealth builds an important component of the German health reform of 2003 [37,38]. It should help to improve the quality of the German healthcare system, its efficiency and patient empowerment. The eHealth project starts with the German electronic health card (Elektronische Gesundheitskarte; eGK), which should be augmented step by step (adding emergency data, selected discharge documents, image data) to build a central component of the national EHR system in the future. The *gematik GmbH*, which was founded in 2005, is responsible for the implementation and maintenance of the eGK and the subsequent projects like the national EHR system. It is owned to 50% by the healthcare payers and to 50% by the providers. After concluding the conceptual phase of the eGK project in March 2005 first field tests were started. After several postpone-

ments it is now planned to start the eGK implementation in October 2009 in the German region Nordrhein with basic functionality [46]. Further dates for the implementation of the national EHR system are not yet published.

### Documented problems of the national EHR program

Based on experience relating to the eGK project the following problems were reported by Weber [26] from the Fraunhofer Institute: (a) difficulty of achieving stringent planning and control, (b) planning rendered complex by the excessive time taken to make political decisions and, simultaneously, rigid completion deadlines, (c) insufficient time allocated for the project planning phase, (d) underestimation of complexity, (e) the limited availability of qualified resources, and (f) insufficient attention given to further development and adaptability during the phase of conception itself.

In an acceptance analysis of the eGK [25] the following problems were reported in addition to the above mentioned: (a) adherence to project schedules and plans, (b) underestimation of complexity, (c) difficulties in setting up a suitable decision structure, and (d) agreement concerning the implementation strategy because of the different viewpoint of stakeholders with regard to the project.

In [10] Trill states the following potential problems of a comprehensive introduction of the eGK in Germany: (a) acceptance problems on the part of the general population accompanied by a more pronounced desire for information, (b) acceptance problems or even resistance from doctors resulting from the impression that the primary purposes are to save costs and achieve greater control, (c) skepticism concerning data protection/data safety, (d) costs, and (e) difficulty to introduce the program because of far-reaching changes in processes.

A recent survey among insured persons also revealed the following: (a) the enhanced need for information on the part of the general population, and (b) uncertainty concerning data protection in one third of the population [29].

The 111th German Doctors' Day (111. Deutscher Ärztetag) [9] showed that the medical community strongly resisted the eGK project. The main points of criticism were the following: (a) poor demonstration of the added value, (b) the technical solution (primarily central servers), (c) the possibility of violating data protection and data safety, (d) insufficient attention being given to doctors' daily routine, and poor alignment with the requirements of doctors, and (e) inadequate analysis of overall costs.

Furthermore, problems were delineated in respect of (a) the accuracy of the cost-benefit analysis [27,28], (b) the ability to provide adequate funds and the distribution of the investments [27,37], and (c) decisions concerning the technical architecture [30, 31].

### 4.1.3 Canada

The program is initiated by the ministry of health and aims to achieve higher quality and safety in patient care, as well as more consistent and efficient use of health system resources [20]. In January 2001 *Canada Health Infoway* was founded, a non profit organisation that acts in a strategic investor role to promote the nationwide implementation of interoperable EHRs. The implementation itself is done by the provinces. The plan is to provide EHRs for 47% of the Canadian population until the end of 2010.



## Documented problems of the national EHR program

In the course of an external consulting project [20] the following potential problems were identified with regard to the implementation of national EHRs: (a) convincing presentation of benefits, (b) the end users' acceptance and change management, (c) changes in basic processes in order to generate added value from these, (d) the availability of healthcare IT specialists and change leaders, (e) inadequate political support, and (f) local and regional funding.

After one half of the project term had elapsed, Canada Health Infoway was analyzed by an external consultant with regard to the achievement of its goals [11]. The following problems were identified: (a) problems relating to an inadequate budget because of changes in funding, (b) problems relating to local/regional funding and setting priorities in the provinces, (c) in personnel expertise, and (d) in project management.

### 4.1.4 Denmark

Since the end on the 1990s the Danish ministry of health pushes the use of HIT to improve the efficiency and effectiveness of the Danish healthcare system [32]. The goal is to achieve integrated seamless patient care and better patient involvement. In 1994 *MedCom* was founded as the national coordination organisation for HIT. All important stakeholders are part of this organisation and jointly finance MedCom. MedCom defined electronic data interchange formats for the most relevant health information to be shared and supports its exchange over the Danish Health Data Network. In 2003 a portal was added for providers and later also for patients. In 2006 98% of the Danish GPs, all 73 hospitals and all 331 pharmacies shared data over the network, about 80% of the totally exchanged healthcare information was sent electronically.

## Documented problems of the national EHR program

According to Edwards from the Gartner group [21] lessons learned during the implementation of the national Danish EHR program were: (a) start with the principal basic needs, (b) set up a process of continued monitoring and evaluation, (c) align the incentive systems for the involved persons, (d) consistent implementation of data protection and data safety while also fulfilling the requirements of clinicians and patients, (e) set up an appropriate balance between central coordination and local management, and (f) dedicate a large quantity of resources to local implementation and training to support changes as well as gain the acceptance of clinicians.

The Danish Centre for Health Telematics [32] rates the following as significant factors: (a) national, regional and local commitment, (b) the cost-effectiveness of the program, (c) close cooperation between clinicians and developers, (d) efficient project management, (e) testing and certification of software solutions and operators, and (f) an intensive information and promotion policy.

During an EU project on benefit analysis [34] the following were reported as the “lessons learned” in Denmark: (a) significance of the alignment of eHealth Vision with political willingness, (b) the need to define and evaluate long-term goals and strategies, (c) the need to define precise and accepted standards, (d) the need to acquire the support of all relevant stakeholders, (e) the need for consensus, team work and collaboration with stakeholders, (f) the need for changes in organization and processes in order to realize the benefits, (g) the significance of stepwise implementation based on achieved success, (h) the realization that technical implementation is not enough; the final user must also be able to see the potential and be willing to utilize it, (i) the realization that

existing solutions should not be replaced as long as they serve their purpose, (j) the need for effective, persistent and consistent project management, and (k) the need to distribute internal and external MedCom activities in a meaningful way.

#### 4.1.5 Australia

The national EHR system is an important project in the modernization of the Australian Healthcare system [22,47]. The Australian EHR system, which is called *HealthConnect*, is based on a cooperation project of the Australian government and the states and territories. Its goal is to achieve patient empowerment, quality improvements and higher efficiency of the health system. In 2004 the *National eHealth Transition Authority (NEHTA)* was founded to support the ministry of health in the realization of the EHR project. Their task is to coordinate the implementation of an interoperable infrastructure, select the relevant standards and terminologies, define patient and provider identifiers and support the necessary legislation. NEHTA consist of members of federal, state and territory governments. The national EHR system is planned to be implemented until 2014. Important parts of the architecture and the standards are already specified (excluding the identifier and security concepts) and several regional pilots have been implemented in Tasmania and the Northern Territory. The rollout for Tasmania is planned for Mid 2009.

#### Documented problems of the national EHR program

One of the results of an EHR research project [36] was that the following risks were identified with regard to the implementation of HealthConnect in Australia: (a) concerns about data protection, safety and confidentiality, (b) the users' acceptance, (c) the

complexity of program management, (d) high investments, and (e) political commitment.

In the course of an IT strategy project conducted by an external consulting company in 2004 [6] the following problems were identified in eHealth activities conducted thus far: (a) insufficient prioritization of several small projects without a delineated national line, (b) the absence of standards for key areas and the long time taken to make standard decisions, (c) fragmented responsibilities in national committees because of part-time work and no executives who worked full-time, as well as deficient resources and governance, (d) regional funding, (e) presentation of the added value, (f) underestimation of change management tasks among service providers with regard to the utilization of IT, (g) slow progress due to poor IT utilization by doctors, (h) poor broad-band network connections in provincial areas, (i) the meager importance assigned to the EHR program at the political level, and (j) frustration among stakeholders due to slow progress.

After the EHR project had been reorganized and the NEHTA had been founded, a further review was conducted by a consulting company in 2007 [22]. The following weaknesses were identified: (a) inadequate stakeholder management and regional cooperation by the NEHTA and meager importance given to external requirements, (b) bottlenecks in resources in terms of the necessary skills, (c) poor transparency towards NEHTA work plans and lack of communication of intermediary results, (d) unrealistic expectations due to poor transparency with regard to the actual goals and tasks of NEHTA, and (e) weaknesses in the decision and governance structure.

## 4.2 Derivation of critical areas

A number of similar detailed problems were identified in the analysis of the national EHR programs of individual countries (compare section 4.1). These were abstracted in order to make cross-country comparisons, and were summarized into so-called critical areas of national EHR programs.

<b>Critical area</b>	<b>GB</b>	<b>DE</b>	<b>CA</b>	<b>DK</b>	<b>AU</b>
<b>Acceptance, Change management (14)</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>3</b>
Integration of clinicians	[51](b)(j), [52](c)(j), [24](e)	[9](d)		[32](c), [34](d)(e)	[22](a)(c)
Doctors' acceptance	[51](d), [52](b), [23]	[10](b)	[20](b)	[21](c)(f), [34](h)	[36](b), [6](f)(g)
Acceptance by the general population / more information required	[51](d)	[10](a), [29](a)			
Organizational change	[51](g), [52](g)	[10](e)	[20](c)	[34](f)	[6](g)
<b>Demonstration of benefits, Funding (14)</b>	<b>3</b>	<b>5</b>	<b>2</b>	<b>2</b>	<b>2</b>
Cost-benefit analysis, ongoing monitoring of benefit	[51](f), [52](d)(e)			[21](b), [32](b)	
Uniform calculation approaches and amortization periods		[27](a), [28](a), [9](e)			
Problems associated with communicating benefits in a convincing manner	[52](b)	[9](a)	[20](a)		[6](e)
High investment, distribution between the concerned persons		[37](b), [27](b), [10](d)	[11](a)		[36](d)
Regional / local co-funding and their prioritization	[7](b)		[20](f), [11](b)		[6](d)
<b>Project management (12)</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>
Adherence to project schedules and plans (identifying the complexity of projects)	[51](a), [52](a)	[25](a), [26](a)(b) (d)		[32](d)	[6](j)
Setting up a suitable decision and governance structure		[25](c)		[34](j)	[36](c), [6](a), [22](e)
Resources and skills	[52](f), [24](d)	[26](e)	[20](d), [11](c)(d)	[34](k)	[6](c), [22](b)
<b>Health-policy-related goals and implementation strategy (11)</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>2</b>
Political commitment, realizing the political significance	[51](e)		[20](e)	[32](a), [34](a)(b)	[36](e) [6](i)
Selection of a suitable implementation strategy	[51](e)	[25](d)		[21](a)(g), [34]	
Centralized / Decentralized distribution of tasks	[51](c), [52](h), [8](b)			[21](e)	
Integration / Replacement of existing application systems	[51](h), [52](i), [8](a),			[34](i)	

Critical area	GB	DE	CA	DK	AU
	[7](a)				
<b>Basic legal conditions, Data protection (8)</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>1</b>
Skepticism with regard to data protection and confidentiality	[51](i), [52](k)	[10](c), [29](b), [9](c)		[21](d)	[36](a)
No data protection regulations at the time of assignment	[24](c)				
The "opt-out" model is dubious	[24](f)				
<b>Technical solution (4)</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>1</b>
Decision concerning architecture		[9](b), [30](c), [31](c)			
Network connection					[6](h)
<b>Standards (2)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>
Precise assignment of standards, long time taken to make decisions				[34](c)	[6](b)
<b>Others (4)</b>	[24](a)(b)	[26](c)(f)		[32](e)	[22](d)

Table II – Critical areas identified in national EHR programs of England (GB), Germany (DE), Canada (CA), Denmark (DK), and Australia (AU) arranged according to the frequency of the subsidiary detailed problems. We refer to chapter 4.1 with regard to detailed problems - the source publication is mentioned in squared brackets and the index used in 4.1 for the detailed problem within the publication is shown in round brackets. Problem categories which the individual detailed problems are grouped under in a cross-country manner are shown as indented entries. The numbers in the columns right of each critical area show for each individual country how often a subsidiary detailed problem assigned to the respective critical area has been reported in literature; the sum of these numbers per critical area is shown in round brackets after the name of each critical area. Note that publications in which more than one detailed problem per critical area are mentioned are counted only once per critical area in order to prevent the ordering of the critical areas from being influenced by the subjective choice of problem categories.

In the following, we summarize the conclusions drawn from the critical areas of national EHR programs as shown in Table II. For each of the critical areas arranged according to the frequency of the subsidiary detailed problems, the most widespread problematic areas, i.e. those reported by at least three of five countries are mentioned. Furthermore, the measures reported in the published literature for each critical area are described. These measures may be regarded as the strength of the specific country and were used to cope with sub-aspects or detailed problems in the critical area:

### 4.2.1 Acceptance and change management

The most significant critical area for which problematic cases were registered in all countries is the *acceptance* of the EHR solution and the required *change management* in the processes and cultures of the involved persons. This is especially true for the problems reported in all countries, resulting from doctors being poorly convinced of the EHR solution and its personal added value for them. Furthermore, doctors have been poorly integrated into the general execution of the project in four of five countries. Difficulties in implementing the necessary organizational changes have also been raised as a point of criticism.

#### Useful measures

In England, communication through a website that provides information about the progress of the project is mentioned as a useful measure for this critical area [7]. Canada is actively investing energy in the end users' acceptance and is providing appropriate supportive tools to enhance acceptance [11]. In Denmark, motivation is increased by using public monitoring as an incentive. Likewise, financial incentives are provided for doctors who use the application [21]. Besides, the consensus culture, teamwork and collaboration with stakeholders are classified as useful measures [21,34].

### 4.2.2 Demonstration of benefits and funding

The same numbers of problems were cited in the five countries in respect of *demonstration of benefits* and *funding*. For four of the five countries, convincing communication about benefits is a difficult challenge. In the sector of funding, the high investments

and their distribution between the concerned stakeholders have been cited as problems in three countries. Problems relating to regional / local co-funding and their prioritization have also been mentioned in three countries.

### Useful measures

Timely dedication of financial resources has been cited as a useful measure for this critical area in England [7]. In Canada as well, dedicated funding is emphasized as a useful measure [11]. A benefit evaluation framework to measure benefits was also developed here [11]. In Denmark, proving the actual saving of financial resources during actual daily operation was shown to be a useful measure [33,34].

### 4.2.3 Project management

*Project management* was identified as a further critical area. One difficulty in all countries is the insufficient availability of appropriate resources and skills in the field of project management, change management and healthcare IT specialists.

In four countries, problems associated with adherence to project schedules and plans were reported. They result from poor estimation of the complexity of the project. Problems associated with the establishment of a suitable decision and governance structure were reported in three countries.

### Useful measures

Useful measures for this critical area, according to reports from England, are the following: recruitment of highly qualified and capable staff and executives in the central team [7,17], stringent performance monitoring [51], control mechanisms during changes in the project [51], and communication of the status of the project [51]. Professional port-



folio management [11], knowledge management and solution re-use [11] have been described as solutions in Canada. In Denmark, realistic scheduling [21] has been reported as a positive measure.

#### 4.2.4 Health-policy-related goals and implementation strategy

*Health-policy-related goals and selection of suitable implementation strategies* is a further critical area. Insufficient political commitment has been reported in four countries; it was also reported that the health-policy-related significance of the project was underestimated. Problems associated with selection of the suitable implementation strategy were encountered in three countries.

##### Useful measures

In Denmark, a stepwise approach and a strategy based on previous success were emphasized as useful measures for this critical area [21,34]. An appropriate balance of tasks, at a centralized as well as decentralized level, was also rated positively [21]. Useful measures reported from England were a high degree of political sponsorship and commitment [7,17,24], speed of assignment, professionalism in negotiations [51], intensive management of the procurement chain [51], and strict contractual agreements for payments to suppliers [7,17,51]. In Canada, strategic cooperation between the national and regional echelons, and the implementation of the strategic investor role were highlighted as positive measures [11,20].

#### 4.2.5 Basic legal conditions and data protection

Safeguarding *basic legal terms and conditions* as well as *data protection* were identi-

fied as a critical area. Concerns and skepticism in the sector of data protection and confidentiality were mentioned in four countries.

### Useful measures

Canada decided to institute the supportive measure of providing central support for the provinces by way of informative material and a combined flexible safety architecture. Additionally, central evaluation of adherence to legal regulations was emphasized as a positive measure [11].

#### 4.2.6 Technical solution and standards

The sectors of *technical solution* and *standards* were named as problematic areas only in two countries.

### Useful measures

In England professional hosting of applications [7] was reported as a positive measure. In Canada the standards are promoted by coupling these with funding [11]. In Denmark as well, promoting adaptation to a common standard [21] and close cooperation with clinicians [21] were deemed beneficial.

## 5 Discussion

The presented analysis of national EHR programs in five different countries showed that a large number of problems have been reported in a small number of sub-areas of the project, which may thus be seen as critical areas of national EHR programs. With

regard to the characteristics of the critical areas it was found that, in most cases, strategic, organizational and human challenges are more complex and difficult to cope with than technology alone.

From the authors' point of view, the reason for rare mention of problems in the areas of *technical solution* and *standards* lies in the fact that these subjects are regarded as the core tasks of EHR programs in most countries. One is compelled to address these areas in detail. However, EHR programs are liable to focus too heavily on technology. This would not be successful if one did not devote equally careful attention to the other named areas. The areas of *acceptance, change management, demonstration of benefits, funding, project management, health-policy related goals and implementation strategy, and basic legal conditions, data protection* must be given at least as much importance at the very start of the project as technological aspects are given.

With regard to the selected method we find that critical areas of national EHR programs can be successfully derived from abstraction of the documented detailed problems. However, the utilized sources of detailed problems are limited to the extent that only project reviews and audits were analyzed. Given the rapid developments in this sector we may assume that all relevant information concerning the individual EHR programs have not yet been published. Furthermore, the information provided by the countries originates from a broad spectrum of different backgrounds and this renders comparisons difficult.

## 6 Future perspectives

As a future step the results of our analysis could be crosschecked and potentially supplemented by an additional standardized survey. This should not only include the EHR

coordination offices in the individual countries but also take into account primary stakeholders (such as the health ministry, persons in charge of decentralized implementation of the EHR, professional representatives, and patient representatives).

Given the identifiable parallels in the problems reported by the individual countries, successful coping strategies for the demonstrated critical areas should be developed. Several measures that proved to be useful in individual countries were described in section 4.2. In the following, some additional options for this purpose will be delineated. However, future research projects would be required in order to work out and align the generic approaches to the specific requirements of national EHR programs.

With regard to the acceptance of the EHR solution, for instance, methods of change management could be utilized from the very start of the project. To support the establishment of working out health-policy goals and implementation strategies, methods of strategy development and IT strategies or strategic IT alignment could be used such as the fundamental concepts defined more than 15 years ago in [67]. To specify goals in such a complex project involving several persons, a balanced score card [68] might be helpful; it could also assist in measuring benefits. For project and program management, professional methods such as Gareis, PRINCE 2 and PMI [69,70,71] should be used and critical areas should be given special attention. For the demonstration of costs and benefits, EHR-specific approaches to measure cost-benefit ratios should be worked out. For instance, the procedure described in [14] could serve as a basis. For ongoing measurement of benefit, in addition to the previously mentioned balanced scorecard, the DeLone and McLean model of information systems success [72] could be used to measure the success of the EHR solution. To support the legal sector, a legal framework including relevant areas and alternatives to be considered would be a valuable aid even when the subject is largely country-specific. The EHR framework devel-

oped by the EU data protection group [73] might well be used as a basis for this purpose.

The above mentioned methods suggested for the various critical areas may be viewed as itemized solutions. For the future it would be desirable to establish a comprehensive method for national EHR programs. The authors are currently working on aligning the identified methods to the specific requirements of EHR implementations and integrating these into a comprehensive overall method. In addition, the method will cover important contextual aspects of a national EHR implementation and, based on country-wide analyses, emphasize critical areas or, if applicable, highlight successful approaches in some countries. The solutions recommended in the published literature will be integrated into the overall concept. The method will support adequate flexibility so that it can be used to fulfill the diverse requirements of the individual countries.

## Summary table

What was already known on the topic:

- EHRs are widely regarded as an opportunity to effect a fundamental improvement in the public health sector. Most industrial countries therefore pursue national EHR programs.
- As numerous project reviews reveal, national EHR programs are frequently affected by different kinds of problems. In view of their long duration and costs, efficient implementation of the programs with due regard given to the experiences made thus far would be economically desirable.
- The existing literature does not offer the aspired cross-country analysis of critical areas of national EHR programs.

What this study added to our knowledge:

- A large number of problems have been reported in a small number of sub-areas of the project, which may thus be seen as critical areas of national EHR programs.
- Additional evidence was found that with regard to the characteristics of the critical areas, in most cases, strategic, organizational and human challenges are more complex and difficult to cope with than technology alone. This insight, which was reported earlier for other IT domains, could be confirmed to be valid also for the implementation of national EHR programs.
- Successful coping strategies for the demonstrated critical areas should be developed. Although existing approaches may be adapted to the specifics of national EHR programs, these may be viewed as itemized solutions. For the future it would be desirable to establish a comprehensive method for national EHR programs.

## References

1. International Organisation for Standardisation (ISO). EHR Definition, Scope and Context. 2005. Technical Report No.: ISO/TR 20514:2005(E).
2. WHO Global Observatory. Building Foundations for eHealth [monograph on the internet]. Geneva: WHO Press; 2006 [cited 2009 Feb 27]. Available from: [http://www.who.int/ehealth/resources/bf\\_full.pdf](http://www.who.int/ehealth/resources/bf_full.pdf) (accessed 24.02.2009)
3. European Commission. eHealth priorities and strategies in European countries [monograph on the internet]. Luxembourg: Office for Official Publications of the European Communities; 2007 [cited 2009 Feb 27]. Available from: [http://ec.europa.eu/information\\_society/activities/health/docs/policy/ehealth-era-full-report.pdf](http://ec.europa.eu/information_society/activities/health/docs/policy/ehealth-era-full-report.pdf) (accessed 24.02.2009)
4. European Commission. e-Health - making healthcare better for European citizens: An action plan for a European e-Health Area [monograph on the internet]. Brussels; 2004 [cited 2009 Feb 27]. Available from: [http://ec.europa.eu/information\\_society/doc/qualif/health/COM\\_2004\\_0356\\_F\\_E\\_N\\_ACTE.pdf](http://ec.europa.eu/information_society/doc/qualif/health/COM_2004_0356_F_E_N_ACTE.pdf) (accessed 24.02.2009)
5. Capgemini. Health Information Technology and the Electronic Health Record

- Implications for Healthcare [monograph on the internet]. 2005 [cited 2009 Feb 27]. Available from: [http://www.dk.capgemini.com/resources/thought\\_leadership/health\\_information\\_technology\\_and\\_the\\_electronic\\_health\\_record/?d=1](http://www.dk.capgemini.com/resources/thought_leadership/health_information_technology_and_the_electronic_health_record/?d=1) (accessed 24.02.2009)
6. Boston Consulting Group. National Health Information Management Information & Communications Technology Strategy. 2004.
  7. Edwards J. Connecting for Health: The Way Forward in a Time of Radical Change. Gartner Industry Report 7. 2006 Dec. Report No.: G00141723.
  8. Brennan S. The biggest computer programme in the world ever! How's it going?. Journal of Information Technology. 2007; 22: 202-11.
  9. Bundesaerztekammer. Beschlussprotokoll des 111. Deutschen Aertztages vom 20. – 23. Mai 2008 in Ulm [monograph on the internet]. Ulm; 2008 [cited 2009 Feb 27]. Available from: <http://www.bundesaerztekammer.de/downloads/111DAETBeschlussprotokoll200808251.pdf> (accessed 24.02.2009)
  10. Trill R. eGK - ein Einstieg in die flächendeckende Sektoren übergreifende Telematik? - Eine Betrachtung aus Krankenhaussicht. Telemedizin Fuehrer Deutschland. 2006; 10-14.
  11. BMB Consulting. 2006 Performance Evaluation (Mid-Term) [monograph on the internet]. 2006 [cited 2008 Jan 19]. Available from: [http://www.infoway-inforoute.ca/Admin/Upload/Dev/Document/Infoway\\_EvaluationReportEN.pdf](http://www.infoway-inforoute.ca/Admin/Upload/Dev/Document/Infoway_EvaluationReportEN.pdf) (accessed 19.1.2008)
  12. Edwards J. Critical Success Factors for Electronic Health Record Programs (Stakeholder and Vendor Relationship Management). Gartner Industry Report 28. 2007 Feb. Report No.: G00146760.
  13. Edwards J. Critical Success Factors for Electronic Health Record Programs (Business Strategy, Governance and Project Planning). Gartner Industry Report 28. 2007 Feb; Report No.: G00146439.
  14. Stroetmann KA, Jones T, Dobrev A, Stroetmann VN. eHealth is Worth it - The economic benefits of implemented ehealth solutions an ten European sites [monograph on the internet]. Luxembourg: Office for Official Publications of the European Communities; 2006 [cited 2009 Feb 27]. Available from: <http://www.ehealth-impact.org/download/documents/ehealthimpactsept2006.pdf> (accessed 24.02.2009)
  15. Medical Records Institute. Medical Records Institute's Survey of Electronic Health Record Trends and Usage for 2006 [monograph on the internet]. Aspen Publishers, Inc.; 2006 [cited 2009 Feb 27]. Available from: [http://www.accessmylibrary.com/coms2/summary\\_0286-26821650\\_ITM](http://www.accessmylibrary.com/coms2/summary_0286-26821650_ITM) (accessed 24.02.2009)
  16. Brender J, Ammenwerth E, Nykänen P, Talmon J. Factors Influencing Success and Failure of Health Informatics Systems. Methods Inf Med. 2006; 1: 125-36.
  17. Protti D, Johansen I, Perez-Torres F. Comparing the application of Health Information Technology in primary care in Denmark and Andalusia, Spain. Int J

- Med Inform. 2009; 78: 270-83.
18. Blumenthal D. The Federal Role in Promoting Health Information Technology, Perspectives on Health Reform [monograph on the internet]. 2009 [cited 2009 Jun 28].. Available from: [http://www.commonwealthfund.org/~media/Files/Publications/Perspectives%20on%20Health%20Reform%20Brief/2009/Jan/The%20Federal%20Role%20in%20Promoting%20Health%20Information%20Technology/1230\\_Blumenthal\\_federal\\_role\\_promoting\\_hlt\\_IT\\_Perspectives%20pdf.pdf](http://www.commonwealthfund.org/~media/Files/Publications/Perspectives%20on%20Health%20Reform%20Brief/2009/Jan/The%20Federal%20Role%20in%20Promoting%20Health%20Information%20Technology/1230_Blumenthal_federal_role_promoting_hlt_IT_Perspectives%20pdf.pdf) (accessed 27.06.2009)
  19. QinetiQ. NHS Connecting for Health Process Capability Appraisal. 2005 Apr.
  20. Canada Health Infoway. 2015 advancing Canada's next generation of health-care at a glance [monograph on the internet]. Canada Health Infoway; 2006 [cited 2009 Feb 27]. Available from: [http://www2.infoway-inforoute.ca/Documents/Vision\\_Summary\\_EN.pdf](http://www2.infoway-inforoute.ca/Documents/Vision_Summary_EN.pdf) (accessed 24.02.2009)
  21. Edwards J. Case Study: Denmark's Achievements With Healthcare Information Exchange [monograph on the internet]. Gartner Industry Report 30; Report No.: G00139713. 2006 May [cited 2009 Feb 27]. Available from: [http://www-03.ibm.com/industries/ca/en/healthcare/files/gartner-case\\_study-denmarks\\_achievementswHIE.pdf](http://www-03.ibm.com/industries/ca/en/healthcare/files/gartner-case_study-denmarks_achievementswHIE.pdf) (accessed 22.06.2009)
  22. Boston Consulting Group. NEHTA Review. 2007 Oct.
  23. Medix. Medix UK plc survey (Q1066) of doctors' views about the National Programme for IT (NPfIT) [monograph on the internet]. Medix; 2006 Nov [cited 2009 Feb 27]. Available from: <http://ixdata.com/reports/106620061121.pdf> (accessed 22.06.2009)
  24. Coiera E. Lessons from the NHS National Programme for IT. MJA. 2007; 186(1).
  25. Fellien U, Hohnhorst S, Nowitzke S. Implementierung der elektronischen Gesundheitskarte und Untersuchung der Akzeptanz bei den Akteuren im deutschen Gesundheitswesen [monograph on the internet]. Berlin: Verlag fuer akademische Texte; 2007 [cited 2009 Feb 27]. Available from: <http://www.grin.com/e-book/110627/implementierung-der-egk-und-untersuchung-der-akzeptanz-bei-den-akteuren#> (accessed 24.02.2009)
  26. Weber H. IT-Großprojekte in Deutschland: Schlecht gemacht oder schlecht geredet?. Fraunhofer Jahresbericht. 2004; 8-17.
  27. Krüger-Brand HE. Projekt Gesundheitskarte - Wegbereiter für neue Dienste; Deutsches Aerzteblatt. 2007; 104(23): A 1677.
  28. Booz, Allen, Hamilton. Endbericht – zur Kosten-Nutzen-Analyse der Einrichtung einer Telematik- Infrastruktur im deutschen Gesundheitswesen. 2006 Jul.
  29. Forsa. Versichertenbefragung: Elektronische Gesundheitskarte. 2008 Apr.
  30. Schweim HG. Die unerträgliche Geschichte der Gesundheitskarte in Deutschland; GMS Medizinische Informatik, Biometrie und Epidemiologie. ISSN 1860-9171; 2007.
  31. Blobel B. Lehren für eGK aus relevanten internationalen Strukturprojekten. In:



- eHealth 2005 - Telematik im Gesundheitswesen, Schriftenreihe der GVG, 51. AKA. Berlin: Gesellschaft für Versicherungswissenschaft und -gestaltung e.V. (GVG); 2005. p. 213-18.
32. Danish Centre for Health Telematics. Synergy across borders [monograph on the internet]. Odense; 2008 [cited 2009 Feb 27]. Available from: <http://www.medcom.dk/dwn406> (accessed 24.02.2009)
  33. Johansen I. Denmark - eHealth and Implementation of Electronic Patient Record in Denmark [monograph on the internet]. Hall in Tirol; 2006 [cited 2009 Feb 27]. Available from: <http://www.ehealth-benchmarking.org/2006/index.php> (accessed 24.02.2009)
  34. Wanscher CE, Pederson CD, Jones T. Descriptive report on site study results: MedCom, Denmark - Danish Health Data Network (DHDN) [monograph on the internet]. Bonn: empirica; 2006 [cited 2009 Feb 27]. Available from: [http://www.ehealth-impact.org/case\\_tool/data/binary/d60e84cfe6b82cf66c5c9443defcccb0.pdf](http://www.ehealth-impact.org/case_tool/data/binary/d60e84cfe6b82cf66c5c9443defcccb0.pdf) (accessed 24.02.2009)
  35. Dansk Standard. Comparing GEPJ with HL7 V3 [monograph on the internet]. 2006 [cited 2008 Apr 19]. Available from: <http://www.epjobservatriet.dk/konference2006/powerpoints/Comparing%20GEPJ%20and%20HL7%20v3.pdf> (accessed 19.4.2008)
  36. HealthConnect Program Office. Overview and findings. 2003. Report No.: Interim Research Report Volume 1.
  37. Bundesministerium fuer Gesundheit – Gesundheitskarte [homepage on the Internet]. Berlin: Bundesministerium fuer Gesundheit [cited 2009 Feb 27]. Available from: <http://www.die-gesundheitskarte.de> (accessed 24.02.2009)
  38. gematik - Gesellschaft fuer Telematikanwendungen der Gesundheitskarte mbH [homepage on the Internet]. Berlin: Gesellschaft fuer Telematikanwendungen der Gesundheitskarte mbH [cited 2009 Feb 27]. Available from: [www.gematik.de](http://www.gematik.de) (accessed 24.02.2009)
  39. DIMDI - Deutsches Institut für Medizinische Dokumentation und Information [homepage on the Internet]. Berlin: Bundesministerium fuer Gesundheit [cited 2009 Feb 27]. Available from: [www.dimidi.de](http://www.dimidi.de) (accessed 24.02.2009)
  40. Jaeckel A, editor. Telemedizinführer Deutschland. 7th ed. Bad Nauheim: Minerva; 2006.
  41. Jaeckel A, editor. Telemedizinführer Deutschland. 8th ed. Bad Nauheim: Minerva; 2007.
  42. Hempel V, Jaeckel A, Reum L, editors. Telemedizinführer Deutschland. 2. Sonderausgabe, Modellregionen, Projekte und Initiativen zur elektronischen Gesundheitskarte in Deutschland und Europa. Bad Nauheim: Minerva; 2006.
  43. IBM Deutschland GmbH. bit4health: Rahmenarchitektur für die Telematikinfrastruktur des Gesundheitswesens - Ein Überblick [monograph on the internet]. 2004 [cited 2009 Feb 27]. Available from: <http://www.dimdi.de/dynamic/de/ehealth/karte/downloadcenter/technik/rahmena>

- [rchitektur/telematik\\_rahmenaktuell/b4h\\_ueberblick\\_v\\_1-1.pdf](#) (accessed 24.02.2009)
44. IBM Deutschland GmbH. Skizzierung der Lösungsarchitektur und Planung der Umsetzung (Solution Outline) [monograph on the internet]. 2004 [cited 2009 Feb 27]. Available from: [http://www.dimdi.de/dynamic/de/ehealth/karte/downloadcenter/technik/solutionoutline/solution\\_outline\\_aktuell/b4h\\_solutionoutline\\_v1-1.pdf](http://www.dimdi.de/dynamic/de/ehealth/karte/downloadcenter/technik/solutionoutline/solution_outline_aktuell/b4h_solutionoutline_v1-1.pdf) (accessed 24.02.2009)
45. IBM Deutschland GmbH. Planungsauftrag eRezept, eArztbrief, ePatientenakte und Telematikinfrastruktur [monograph on the internet]. 2004 [cited 2007 Dec 8]. Available from: <http://www.pkv.de/telematik/Projektdokument%20Planungsauftrag%20final.pdf> (accessed 8.12.2007)
46. Bundesministerium für Gesundheit. Pressemitteilung Nr.52 : Einführung der elektronischen Gesundheitskarte im Plan – Krankenkassen starten Ausgabe ab 1. Oktober 2009 [monograph on the internet]. 2009 [cited 2009 Jun 29]. Available from: [http://www.bmg.bund.de/clin\\_110/SharedDocs/Downloads/DE/Presse/Presse-2009/Presse-2009/PM-PDF-09-06-09-eGK\\_templateId=raw,property=publicationFile.pdf/PM-PDF-09-06-09-eGK.pdf](http://www.bmg.bund.de/clin_110/SharedDocs/Downloads/DE/Presse/Presse-2009/Presse-2009/PM-PDF-09-06-09-eGK_templateId=raw,property=publicationFile.pdf/PM-PDF-09-06-09-eGK.pdf) (accessed 29.06.2009)
47. Australian Government Department of Health an Ageing – Health Connect [homepage on the Internet]. Australian Government Department of Health an Ageing [cited 2009 Feb 27]. Available from: <http://www.health.gov.au/internet/main/publishing.nsf/Content/EHealth+Healthconnect> (accessed 24.02.2009)
48. HealthConnect Program Office. The HealthConnect Implementation Approach [monograph on the internet]. 2004 [cited 2009 Feb 27]. Available from: <http://www.health.gov.au/internet/hconnect/publishing.nsf/Content/implementation-approach> (accessed 24.02.2009)
49. HealthConnect Program Office. What will HealthConnect cost and is it sustainable? [monograph on the internet]. 2003 [cited 2009 Feb 27]. Available from: <http://www.health.gov.au/internet/hconnect/publishing.nsf/Content/evaluation-2> (accessed 24.02.2009)
50. METU-SRDC. RIDE D.2.1.1 - Current European practices in providing interoperability in eHealth domain: HEALTHCONNECT and NEHTA (Australia) [monograph on the internet]. 2006 [cited 2009 Feb 27]. Available from: <http://www.srdc.metu.edu.tr/webpage/projects/ride/deliverables/RIDED.2.1.1%20-%20CurrentPracticesAustralia.doc> (accessed 24.02.2009)
51. Bourn J. The national Programme for IT in the NHS [monograph on the internet]. London: National Audit Office, Department of Health; 2006 [cited 2009 Feb 27]. Available from: <http://www.nao.org.uk/idoc.ashx?docId=01f31d7c-0681-4477-84e2-dc8034e31c6a&version=-1> (accessed 24.02.2009)
52. House of Commons Committee of Public Accounts. Department of Health: The

- National Programme for IT in the NHS [monograph on the internet]. London: The Stationary Office Limited; 2007 [cited 2009 Feb 27]. Available from: <http://www.publications.parliament.uk/pa/cm200607/cmselect/cmpubacc/390/390.pdf> (accessed 24.02.2009)
53. NHS Connecting for Health. Business Plan 2005/2006 [monograph on the internet]. 2005 [cited 2009 Feb 27]. Available from: [http://www.sunderland.nhs.uk/TPCT/about\\_us/board/2005/sep/docs/enclosure10a.pdf](http://www.sunderland.nhs.uk/TPCT/about_us/board/2005/sep/docs/enclosure10a.pdf) (accessed 24.02.2009)
54. NHS Connecting for Health. Status Summary 2007 [monograph on the internet]. 2007 [cited 2009 Feb 27]. Available from: <http://www.connectingforhealth.nhs.uk/about/case/npfitstatus.pdf> (accessed 24.02.2009)
55. Canada Health Infoway. Version 2 [monograph on the internet]. 2006 [cited 2008 Jan 19]. Available from: <http://knowledge.infoway-inforoute.ca/en/knowledge-centre/ehrs-blueprintv2.aspx> (accessed 19.1.2008)
56. Canada Health Infoway. Corporate Business Report 2005-2006, Building on our Successes [monograph on the internet]. 2006 [cited 2008 Jan 19]. Available from: <http://www.infoway-inforoute.ca/Admin/Upload/Dev/Document/Business%20Plan%2005-06%20EN.pdf> (accessed 19.1.2008)
57. Canada Infoway [homepage on the Internet]. Health Canada [cited 2009 Feb 27]. Canada's Health Infostructure History; [1 screen]. Available from: [http://www.hc-sc.gc.ca/hcs-sss/ehealth-esante/infostructure/hist\\_e.html](http://www.hc-sc.gc.ca/hcs-sss/ehealth-esante/infostructure/hist_e.html) (accessed 24.02.2009)
58. Danish Ministry of the Interior and Health. National IT Strategy for the Danish Health Care Service 2003-2007 [monograph on the internet]. 2003 [cited 2009 Feb 27]. Available from: [http://www.sst.dk/publ/Publ2004/National\\_IT\\_strategy.pdf](http://www.sst.dk/publ/Publ2004/National_IT_strategy.pdf) (accessed 24.02.2009)
59. METU-SRDC. RIDE D.2.1.1 - Current European practices in providing interoperability in eHealth domain: Danish Healthcare System [monograph on the internet]. 2006 [cited 2009 Feb 27]. Available from: <http://www.srdc.metu.edu.tr/webpage/projects/ride/deliverables/RIDED.2.1.1%20-%20CurrentPracticesDenmark.doc> (accessed 24.02.2009)
60. Danish Ministry of the Interior and Health. The Danish eHealth experience: One Portal for Citizens and Professionals [monograph on the internet]. 2004 [cited 2009 Feb 27]. Available from: [http://www.sundhed.dk/Images/alle/redaktion/english/The\\_Danish\\_eHealth\\_experience.pdf](http://www.sundhed.dk/Images/alle/redaktion/english/The_Danish_eHealth_experience.pdf) (accessed 24.02.2009)
61. European Commission. Benchmarking ICT use among General Practitioners in Europe [monograph on the internet]. 2008 [cited 2009 Feb 27]. Available from: [http://ec.europa.eu/information\\_society/eeurope/i2010/docs/benchmarking/gp\\_survey\\_final\\_report.pdf](http://ec.europa.eu/information_society/eeurope/i2010/docs/benchmarking/gp_survey_final_report.pdf) (accessed 26.06.2009)

62. The Commonwealth Fund. The Commonwealth Fund 2006 International Health Policy Survey of Primary Care Physicians in Seven Countries [monograph on the internet]. 2006 [cited 2009 Feb 27]. Available from: [http://www.commonwealthfund.org/usr\\_doc/Schoen\\_2006intlsurveyprimarycareMDs\\_chartpack.pdf?section=4039](http://www.commonwealthfund.org/usr_doc/Schoen_2006intlsurveyprimarycareMDs_chartpack.pdf?section=4039) (accessed 26.06.2009)
63. House of Commons - Committee of Public Accounts. Department of Health: The National Programme for IT in the NHS, Twentieth Report of Session 2006-07. 2007 March; Report No.: HC390.
64. House of Commons – Standing Committee on Health. Review of the 10-Year Plan to Strengthen Health Care [monograph on the internet]. 2008 [cited 2009 Feb 27]. Available from: [http://www.cna-nurses.ca/CNA/documents/pdf/publications/Review\\_10\\_Year\\_Plan\\_e.pdf](http://www.cna-nurses.ca/CNA/documents/pdf/publications/Review_10_Year_Plan_e.pdf) (accessed 26.06.2009)
65. Wanscher C, Pederson C, Jones T. Descriptive report on site study results: MedCom, Denmark - Danish Health Data Network (DHDN) [monograph on the internet]. 2006 [cited 2009 Feb 27]. Available from: [http://www.ehealth-impact.org/case\\_tool/data/binary/d60e84cfe6b82cf66c5c9443defcccb0.pdf](http://www.ehealth-impact.org/case_tool/data/binary/d60e84cfe6b82cf66c5c9443defcccb0.pdf) (accessed 26.06.2009)
66. Health Connect. Health Connect Interim Research Report – Overview and findings [monograph on the internet]. 2003 [cited 2009 Feb 27]. Available from: [http://www.health.gov.au/internet/hconnect/publishing.nsf/content/43598FE37A3E7270CA257128007B7EB7/\\$File/v1.pdf](http://www.health.gov.au/internet/hconnect/publishing.nsf/content/43598FE37A3E7270CA257128007B7EB7/$File/v1.pdf) (accessed 26.06.2009)
67. Henderson JC, Vankatraman N. Strategic Alignment: Leveraging information technology for transforming organizations. IBM Systems Journal. 1993; 32(1): 472-84.
68. Kaplan RS, Norton DP. The Balanced Scorecard - Translating Strategy into Action. Boston; 1996.
69. Gareis R. Programmmanagement. In: Happy Projects! 3. Auflage. Vienna: Manz; 2006. p. 401-47.
70. Prince2.com [homepage on the Internet]. Prince 2 Foundation [cited 2009 Feb 27]. Available from: <http://www.prince2.com/> (accessed 24.02.2009)
71. Project Management Institute. A Guide to the Project Management Body of Knowledge (PMBOK Guide): 2000 Edition. Pennsylvania; 2000.
72. DeLone WH, McLean E. The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. Journal of Management Information Systems. 2003; 19(4): 9-30.
73. European Commission. ARTICLE 29 Data Protection Working Party; Working Document on the processing of personal data relating to health in electronic health records (EHR) [monograph on the internet]. Brussels; 2007 [cited 2009 Feb 27]. Available from: [http://ec.europa.eu/justice\\_home/fsj/privacy/docs/wpdocs/2007/wp131\\_en.pdf](http://ec.europa.eu/justice_home/fsj/privacy/docs/wpdocs/2007/wp131_en.pdf) (accessed 24.02.2009)