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eHealth Vision towards Cooperative Patient Care – Domain Fields and Architectural Challenges of Regional Health Care Networks

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Abstract

Numerous eHealth projects and efforts to establish inter-organizational communication and to build up regional health care networks could be observed in the last ten years. Nevertheless the success of such efforts is profoundly different. The aim of this paper is to introduce the lately started regional initiative eHealth.Braunschweig compounding of the major health care players (hospitals, physician offices, nursing services and nursing homes) in the region of Braunschweig, participants from research institutions and industry. We propose in this paper the main goals of the regional initiative eHealth.Braunschweig, its constitution and major approaches. Based on respective literature and our former projects as well as experiences in this field we discuss our vision of a patient-oriented cooperative health care by depicting regional distinctions, identifying the major domain fields in this context and discussing the architectural challenges for the regional health care network eHealth.Braunschweig. In our view this work can be considered as a systematical approach to the establishment of regional health care networks with lasting and sustainable effects on patient-centered health care in a region.

Keywords:

Regional health care networks, Collaborative care, Integrated health care systems, Interdisciplinary communication

Introduction

Medical collaboration and cooperation is considered as an essential need to achieve high-quality and patient oriented health care beyond sectoral boundaries of primary care, secondary care, outpatient care, rehabilitation or home care [1]. Also the application of information and communication technologies in health care systems and the establishment of regional health networks have a positive effect on the data exchange and access, effectiveness of patient care, and communication and coordination within a region [2], [3], [4] and [5].

Although computer based information and communication technologies have been used in health care facilities for several years and electronic medical records within health care institutions are already common and well appreciated, the communication of discharge letters and findings between different institutions is still mainly paper based [6].

Compared to other European countries the German health care system has a poor cost-benefit ratio which causes in connection with the impact of the demographic change and other related problems great further challenges [7]. The present situation is marked by over-, under- or inappropriate supply of health care services as well as the low patient centered orientation of care [8]. Despite general consensus about the importance of coordinated cross-sectoral cooperation in health care networks during increasing cost pressure and rising quality expectations, the required services are not yet area-wide implemented [6].

Due to the demographic change, there is a growing number of older citizens entail a growing number of chronic diseases and polymorbidity [8]. To allow adequate treatment for these kinds of complex diseases a lot of health care providers need to adjust with each other over a long period of time.

Various national and international eHealth projects have been started, with the aim to advance communication between providers in health care networks via information and communication technology (ICT). For example the European Union's project PICNIC (ProfessIonals and Citizens Network for Integrated Care) aim is to define the architecture for mainly flexible IT support delivered by exchangeable components [9],

[10]. An example for a national project is the health care region HealthCapital Berlin-Brandenburg [11]. In general the cooperation compounding of different care providers aims to extend beyond areas of activity, traditional boundaries of different specific disciplines and conventional structures. Furthermore the degree and speed of innovation will be specified by this cooperation [6]. The results of the broad mass of eHealth projects admittedly vary in quality and sustainability. Reasons could be the heterogeneity of the ICT landscape in the German health care system, missing business models to continue established networks, little user compliance as well as slow rethinking among the providers.

Against this background the project eHealth.Braunschweig was started in April 2009. The vision of all members, composed of care providers as well as representatives from science and economy, is the establishment of an interoperating, ICT supported, patient-centered health care network spanning all health care sectors in the region of Braunschweig and the surrounding neighborhood. The main idea of the project is: „Move the information not the patient".

By having a look at the following research questions the project should be effectively realized into practice and the results should have a lasting effect:

Q1: What regional distinctions does Braunschweig offer concerning the establishment of a local health care network supported by information technology?

Q2: What are the domain fields which have to be addressed for the development of a regional health care network and how can these domain fields be supported by modern information and communication technology?

Q3: What architectural challenges do regional health care networks face regarding defined requirements and addressed domain fields?

Materials and Methods

Our investigation is based on our previous work and experiences in the field of transinstitutional sensor-enhanced health information systems [5, 12-14] and integrated health care networks [15-18]. With regard to the respective literature we summarize the regional distinctions and the domain fields of our lately started regional network project eHealth.Braunschweig and then give an overview of architectural considerations for an inter-organizational information and communication platform which is part of the transinstitutional regional health information system. Finally we discuss the relevance of the project for the region and conclude with an outlook on future steps.

Results

Regional Distinctions

The need and effects of electronic communication in health care systems have been approved in many publications [2, 3, 6]. Through the use of information and communication technology (ICT) along the health care supply chain interruptions as well as delays in the workflow and media cracks could be reduced [19]. For instance by the use of electronic and online available discharge letters instead of paper-based discharge letters, which are often missing or incomplete. In this way the percentage rate of re-hospitalization could be reduced which also means a raise in quality of care while saving costs [6]. Based on the former demonstrated problems and future challenges for the German health care system different requirements for the establishment of a regional health care network supported by information technology were initially identified for the eHelath.Braunschweig project. While developing a regional IT- infrastructure for health care networks a wide variety of partly quickly changing economical, political, technical conditions have to be considered [20]. Most important for a well operating and accepted health care network are the specific user requirements and goals. First of all care providers and other shareholders concerned were compiled into collaboration within the eHalth.Braunschweig initiative. The most important participants on care givers side are the Medical Center Braunschweig, which represents the biggest care provider in the region, the German Red Cross (DRK) with representatives of nursing homes and mobile nursing services as well as the Association of Statutory Health Insurance Physicians Lower Saxony with several general practitioners and medical specialists. Further cooperation partners are the City Council of Braunschweig and the Public Health Department, different local house-building companies, the Council of Elderly People, several business companies and research institutions such as the Peter L. Reichertz Institute for Medical Informatics.

By realizing the ideas of eHealth.Braunschweig numerous advantages for participants are expected. In future care providers will benefit from the availability of relevant patient information spanning the entire network in the right place at the right time for the right person. Through the intensive cooperation with care providers new possibilities and innovations can be identified by the local business enterprise sector early. From this follows a head start for the local businesses which eventually results in competitive advantages for the region of Braunschweig. Because of great economic importance of the health care sector these advantages are leading to a multiplication at all levels of the chain in health care as well as public health or economy.

By identifying the requirements of the cooperation partners during several workshops the requirements for the establishment of a health care network were elaborated. The main problems identified by the care providers are e.g. an insufficient communication flow between different institutions in the region as well as poor coordination of care giving organizations along the health care supply chain. Based on these problems the major domain fields to establish a regional health care network will be specified next.

Domain Fields

Based on the project goals and previously described regional distinctions and requirements we identified our fields of activity which have to be addressed in order to achieve the

intention of the regional health care network eHealth.Braunschweig. The main goal of eHealth.Braunschweig is to establish seamless and patient centered health care in the region. This means vertical integration (across different health care sectors) and horizontal integration (across different specialization fields, indications and diseases) of health care processes and at the same time consideration of the patient in the main focus of every process. Therefore ways of information flow should be established and tightened in order to enable a continuous and barrier-free transmission of patient related information between different care givers. Taking into account organizational, functional, workflow-related, technical and financial aspects, we identified in our project different domain fields which depict in our opinion essential parts of inter-organizational communication and collaboration in a regional health care network. Identified domain fields will be described in the following section as main work packages which have already been started in the last month.

The first step towards inter-organizational communication is the establishment of a *consistent inter-organizational information standard* for the information exchange between different care givers (e.g. hospital (H), general practitioner (GP), medical specialist (MS), nursing home (NH) or mobile nursing service (NS)). Despite numerous efforts in the last decade, there is still no agreement in daily practice on a reasonable base data set or information set, which should be transferred e.g. from a general practitioner to the hospital along with hospital admission and back from the hospital to the following care provider after discharge. An information standard at this point should be determined bidirectional at least for the term of hospital admission (from GP/MS/NH/NS to the hospital) and discharge (from hospital to GP/MS/NH/NS). The base information set which should be made available electronically to different care givers, will contribute, in our view, to an effective and purposeful information flow especially at critical time points e.g. before weekend and should also help to reduce time-consuming telephone requests.

The next domain field describes the process-related definition of the *admission and discharge management* as a core part of transinstitutional health care management. Hospital admission and discharge are highly multifactorial activities in which different care giver professional groups inside and outside of the hospital as well as patient relatives are involved. Therefore a lot of problems e.g. delays or lack of information emerge at this point. At the same time as the base information set is specified in an inter-organizational information standard, the processes which are affected by this information should be aligned regarding a barrier-free information flow. This means that the target process definition should facilitate the availability of information and an easy access to it. Similar to the first step relevant processes need to be analyzed and target processes specified in a bidirectional way between care givers in primary and secondary care as well as nursing care and home care for elderly people.

The following domain field arising from the first two fields is the *workflow support* for transinstitutional medical, organizational and administrative processes within a regional health care network. The entire interaction regarding one treatment case at different points of care (e.g. GP, hospital or home care) including medical, organizational and administrative tasks requires workflow monitoring and control mechanisms. Adequate trigger mechanisms within inter-organizational information and communication processes which e.g. initiate the submission of patient data to a document portal after discharge or inform a GP about the discharge of his patient and the availability of documents could support the transinstitutional collaboration and workflows.

In order to support the inter-organizational collaboration tasks and workflows (described above) in a regional health care network via IT, the development and implementation of a *transinstitutional information and communication platform* depicts the next major domain field in the course of the project. Essential functionality of the platform will consist of services which interconnect the backend application systems of care giving network participants (GP or hospital) in order to extract and represent the required information of a patient problem-oriented and purposefully. Ideally system and data integration should be the main goal for the future which can only be achieved by standardization and semantic interoperability of the affected application systems. The next lower level of integration could be given by an architectural model involving web applications or web services which are interacting with each other and the backend applications. The information and communication platform should furthermore provide a role-based and secure access to the information through a web application, if there are no backend applications e.g. for patients, their relatives or also the mobile nursing services.

A fundamental part during the constitution of and operation within health care networks, which often fails into oblivion and does not get enough attention, is the domain field of *network management* and development of *sustainable business and financing models* for regional health care networks and for the continuing operation of the network after the termination of an eHealth project. Network management in a regional health care network comprises different management tasks – information management, patient and network participant administration, strategy definition, monitoring and control as well as controlling and reporting tasks. A major part of information management is the alignment of strategic goals of organizations and the corresponding information system architecture taking into account the specific characterization of health care networks e.g. non-hierarchical governance forms or collective vs. individual interests of network members [15]. In general health care networks can be characterized by means of the DIOGEN classification system along the five axes: network structure, network management system, medical care system, transinstitutional information system architecture and network phase [18].

A further substantial domain field of eHealth.Braunschweig, which differentiates this project from many others, is *intelligent home environment for elderly people* and the integration of sensor-enhanced health information systems into

regional health care networks, their health care processes and information system architectures [21]. Several apartments for elderly people owned by local house-building companies in Braunschweig are going to be prepared as age appropriate apartments for older people and additionally equipped with sensor-enhanced information technology (e.g. accelerometer, motion sensor, bathroom scale, ergometer etc.). The integrated technology helps to develop and provide new health care services (e.g. home monitoring) for older persons in order to support self-sufficient and self-determined life. The collected data should be preprocessed and supplied to the care givers in the regional health care network who are involved into treatment context of the patient or the older person [13], [21]. Other domain fields such as telehealth (e.g. video conferences or consultations), selective information providing concerning personal health and well-being (e.g. for elderly people), common multidisciplinary education and training portals for health care professionals are reasonable and could be integrated into the context of our eHealth project in future.

Architectural Challenges

Regional health information systems comprise health care environments in a certain region, e.g. including hospitals, offices of general practitioners, pharmacies, rehabilitation centers, or organizations for home care as defined in [22]. These information systems are characterized by mainly paper-based communication between the particular institutions even if there may be well established and successful used computer-based ICT infrastructure within one institution. The willingness to share information with other institutions usually depends on historically grown relationships and trustfulness between health care institutions as well as on availability of appropriate applications and their integration with the workflows of several institutions. Haux identified in [22] five current problems of regional health information systems which are the problem of obtaining referential integrity, information logistics problem, terminology problem, stability problem and information management problem. The regional health care networks which are part of the regional health information system are facing these problems when trying to introduce an inter-organizational information infrastructure to support the collaboration within the network.

The architectural challenges for the establishment of an inter-organizational information and communication platform within a regional health care network are still integration and interoperability between heterogeneous applications in different institutions, patient identification beyond institutional borders, workflow support between institutions and workflow adaptation of inter-organizational processes within institutions in order to support collaboration [23], [24]. Compliance with new inter-organizational workflows and processes should be supported and thus could be increased by adequate trigger mechanisms e.g. reminders. Integration of home telematics platforms and sensor-enhanced data with health information systems and applications of health care providers is a major challenge in the context of regional medical and social networks. More services of telemonitoring, telehealth or personal health records will be available in future to the patients and elderly people and thereby more data could be collected and preprocessed by the patient. Therefore the institution *patients' home environment* should be also considered as an important institution within the regional health care network [22]. These architectural considerations should certainly be made with regard to data safety and security which are basic requirements in a distributed information and communication infrastructure dealing with sensible patient data.

Discussion

The importance of inter-organizational collaboration and positive effects of information processing in regional health care networks have often been pointed out and partly found realization in regional projects of integrated care networks. Nevertheless the core problems of integration and interoperability as well as workflow support are still existent and there is a lack of introduction of new solutions into daily health care practice. In our regional health care network eHealth.Braunschweig we aim to work on the described domain fields in cooperation with network members from all organizations in order to identify substantial relevant and significant collaboration tasks, to develop applications to support these tasks and to evolve sustainable and lasting information system architectures which will be embedded into the regional health information system and infrastructure. Our goal is to establish inter-organizational health care processes which support and help the care givers in their daily work, to facilitate easier information exchange and reduce the time spent on data searching and request.

Conclusion

We identified the regional distinctions and requirements for regional health care networks and because of that depicted in our opinion the most important domain fields which should be dealt with in a regional eHealth project. The domain fields were identified as follows: consistent inter-organizational information standard, admission and discharge management, workflow support, transinstitutional information and communication platform, network management, development of sustainable business and financing models and intelligent home environments for elderly people. We also highlighted architectural challenges for the establishment of an inter-organizational information and communication platform within a regional health care network regarding the addressed domain fields. Our future work will concentrate on process analysis, inter-organizational process definition and information standards as well as design and development of a prototype system which can be deployed in the health care network and evaluated by network members.

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