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Electronic Health Records In The Netherlands, Luctor Et Emergo: What Emerged After A Decade Of Struggle?

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ELECTRONIC PATIENT RECORDS IN THE NETHERLANDS, LUCTOR ET EMERGO[1]: WHAT EMERGED AFTER A DECADE OF STRUGGLE?

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Abstract

We present a ten-year-update of the EPR-orientation-model for success of Electronic Patient Records (EPR's), based on our research. An EPR is seen as a way to make healthcare more efficient and effective. Many initiatives lead to the implementation of EPR's, but also regional infrastructures for information- and network services are realized. The law to realize a national EPR is rejected by the Dutch Senate, however.

The EPR-orientation-model characterizes EPR in three orientations: administration, medical technology and care process. The developments in the last decade in the Netherlands are described in relation to the orientations. This leads to the extension of the model with external relations and the enlargement of the intersection between the administration orientation and care process orientation. The four criteria for a successful EPR from the end-user viewpoint are updated to five criteria. In order to be successful an EPR must: 1. Be micro-relevant to the end-users; 2.Provide complete and integrated patient data; 3. Be available and accessible anywhere and anytime; 4. Contain active elements, like alerts, decision support and workflow management; 5. Register data necessary for quality and finance, without extra effort for the care providers.

Keywords: Electronic Patient Record, adoption, healthcare information system

[1] Luctor et Emergo (I struggle and emerge) is the heraldic motto of the province of Zeeland, the part of the Netherlands that has been living in a constant struggle with the sea.

1 Introduction

General practitioners (GP's) in the Netherlands use information systems first for administration and later for patient care for a decade or two. They were ahead of the hospitals and other healthcare organizations. In 2000 some 40 % of the Dutch hospitals expressed the desire to use an Electronic Patient Record, without actually buying one, because the ideal EPR for the Dutch market wasn't available yet (Harmsen 2000). A decade later a survey among 20 hospitals demonstrated the progress: approximately 90% used electronic medical records in one or more departments and 67% used or was implementing electronic nursing records (Krediet, Goossen et al. 2012). So, the implementation of EPR's has really taken off in the Netherlands. It is therefore interesting to investigate whether the EPR-orientation model about success of EPR's we presented in (Michel-Verkerke and Spil 2002), was correct or needs to be adjusted.

1.1 The EPR-orientation model

Many terms and acronyms are used to describe EPR's, that is the reason why we will start with making clear what we mean by an EPR. The definition we use in this article is the definition of a Computer-based Patient Record (CPR), given by Gartner: "A system that contains electronically maintained information about an individual's health status and care. It focuses on tasks directly related to patient care, […] The CPR completely replaces the paper medical chart and thus must meet all clinical, legal and administrative requirements" (Gartner 2012). Our criterion for a successful implementation of an EPR is, whether the EPR is adopted by the intended end-users. We adopted the definition Rogers gives for adoption of an innovation: "the decision to make full use of an innovation as the best course of action available" (Rogers 1995) p.21. In our research and our model we focus on the innovation product, i.e. the EPR, we do not look at the innovation process, i.e. the development of the software and implementation process.

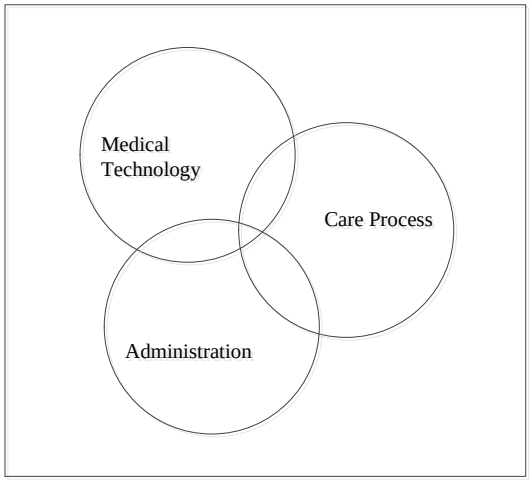

Figure 1. The initial EPR-orientation model (Michel-Verkerke and Spil 2002).

As the care process is related to and supported by other processes in the organization, and care providers are supported by other members of the organization, more internal stakeholders than the care providers have an interest in the EPR. (Mintzberg 1979) can be helpful in categorizing internal groups of stakeholders for the professional bureaucracy: management, support staff, technical staff and operational core. An EPR should be part of the technology which supports the primary and secondary processes in a hospital. Walley and Davis distinguish two categories of technology: medical technology and information technology in their model of the interaction between technology and process (Walley and Davies 2001). In a healthcare organization the information technology is traditionally intertwined with the administration. The model of Walley and Davis translated to the healthcare organization leads to three orientations from which an EPR can be developed:

administration, medical technology and care process. The three orientations are not strictly separated but share processes and interfaces. Figure 1 shows the initial EPR-orientation model (Michel-Verkerke and Spil 2002). An EPR can originate from the medical technology orientation, e.g. as an additional module of the Picture Archive Communication Systems (PACS), or from the administration orientation, e.g. as an additional module of the hospital information system (HIS), or from the care process orientation, e.g. the general practitioner information system (GPIS). The categories of internal stakeholders can be located in each of the orientations as shown in table 1.

Orientation	Administration	Medical technology	Care Process
Stakeholder	Support staff Management	Operational core Technical staff	Operational core Support staff

Table 1. Relation between orientations and stakeholders.

In our article in 2002 we stated that the EPR must cross the borders of its original orientation and be in the intersection of all three orientations, to be successfully adopted (Michel-Verkerke and Spil 2002). We formulated four criteria a successful EPR. An EPR must:

1. be relevant to the end-user,
2. store all data at a patient level in a retrievable and integrated form for any patient,
3. make information available to relevant caregivers, and
4. contain "active" elements.

In section 6.3 the criteria are described and discussed more extensively.

2 Research approach

The objective of the research is to evaluate and update the model, as well as the criteria an EPR must fulfill to be successful. In this research we will answer the questions:

- What is the state of the art in the Netherlands regarding EPR's?
- Does the model need adjustments?
- When will an EPR be successful?

We combined observations of the developments in the ERP-market with literature search and the results of interviews we conducted in the last decade. In order to check the fit of our model as presented in figure 1, we decided to retrospectively analyse the data from a number of case studies. Yin (2009) and Stoop and Berg (2003) have argued in favor of case studies for theory development. Data about the hospitals were collected in 22 interviews. Qualitative studies are capable of generating insights that can explain the effects of healthcare specific peculiarities (Stoop and Berg 2003). Twelve hospitals (general hospitals of medium to large size) were selected (Babbie 1995) and for this study only the role of the medical professional is considered (Trauth 1997). For each orientation we used Miles and Huberman (1994) to analyze the data. For each interview we studied whether the orientation was mentioned or not at all. In addition we looked for statements related to the criteria for successful adoption as developed as part of our research (see paragraph 6.3). In the following sections the situation in the Netherlands is described according to the orientations.

3 Administration orientation

3.1 Situation in 2002

Many healthcare organizations updated their HIS in 2000, because their legacy systems did not support the year 2000 in their programs. It strengthened the point of view where healthcare organizations do not want to be dependent on one supplier. All main players on the Dutch HIS market were developing an EPR. The smallest supplier stayed closest to the patient administration with innovating internet functionalities (CS-EZIS), the middle (on market share) supplier started off in the

direction of care protocols (X/Care) and the largest supplier tried to integrate medical technology in its product (Mirador, EPR Cardiology). Besides that, local initiatives (Zouga and INTRAZIS) tried to use the intranet on top of their legacy systems.

3.2 State of the art in 2012

3.2.1 Observations and developments

In the HIS market, radical changes have taken place. The main players in the Dutch HIS market have been successful with electronic patient records (M&I 2010). The smallest supplier in 2002, ChipSoft, has changed into the biggest supplier in 2012, now serving around 40% of Dutch hospitals, including two out of eight University Medical Centers, with their integrated CS-EZIS system. The middle supplier (McKesson) has introduced a flexible, research based, structured data entry tool, which hasn't seen the uptake it intended. This was in part due to the complexity of configuring the product and to limited integration with both their HIS. The largest supplier in 2002 had announced a new product line, based on the developments for the NHS English market, but has failed to deliver a fully operational product for the Dutch market. Hospitals have started looking elsewhere, but new products have had a hard time to conquer the Dutch market. Only one new player, Epic Systems, has made a real impact on the market, implementing three hospitals and the first to reach HIMSS Analytics Level 6 status on the EMR Adoption Model (EMRAM) score (HiMSS 2011). Siemens is in a difficult position with three limited implementations of their Soarian product, in relatively small hospitals, and a number of SAP IS-H*Med implementations, of which a few have failed. A significant number of hospitals have turned to, or continued their own in-house developments or have implemented third party EPR documentation tools (such as the NORMA product reported in 2002). Most of these hospitals are now seeing the market take shape and are starting or considering replacement of their systems, including their HIS. In other sectors of healthcare, transparency and new financing systems have increased the required functions of a healthcare information system dramatically. Mandatory quality reporting on a patient (process) level has added to this as well. In home care and mental health, time registration has become a key part of the HIS, mainly because financing is based on detailed timecards. In the care for the elderly and handicapped, a system of "care intensity packages" (ZZP, Zorg zwaarte pakket) exists, which means that assessment of the patient determines what care (level and time) will be financed. Without automated information systems it is very hard to comply with all the administrative requirements.

3.2.2 Results of interviews

The administrative orientation is mentioned in only 10 of the 22 interviews analysed. This can be explained by the fact that the interviewees were all specialized physicians, focused on delivering high quality care to the patient. "Physicians are primarily focused on high quality care; profits and savings are less important". If we look at the distribution across the years, we see that the administrative orientation is more prevalent in the later years. This can be explained by the introduction of the new financing system in hospitals in 2005. The new financing system relies on diagnosis and treatment data for billing purposes, data which are typically part of the EPR. According to one interviewee, the integration of the administrative system with the EPR leads to better reimbursement and by that to financial benefits. "There has been an increase of production without additional means, to achieve this in our specialism a good registration tool is necessary." A desire to connect and integrate care and administrative processes is expressed more often. As one specialist puts it: "I envision a hospital wide EPR, which spans from reception to billing"..

4 Care Process orientation

4.1 Situation 2002

In 2002 many initiatives devoted themselves to one group of patients. Examples of these integrated care systems were diabetes systems and the Parkinson card. The entered data could also be used for scientific research (Ubink-Veltmaat, Broekhaar et al. 2001). These projects showed the need for patient centered information systems. At the same time patients were able to make their own personal health record on the Internet. Initiatives for the exchange of messages between hospitals and general practitioners arose. These messages mainly concerned the referral of patients. The general practitioners suffered from legacy systems. Because of the small Dutch market and the large variance of systems, vendors were not interested in developing a new information system for GP's. Home care organizations started to introduce mobile technology for their staff in order to facilitate the registration of the delivered care and time spent (Webers and Ramaekers 2001). It was expected that a care card would be available soon (Loos 2001) and would evolve to a project for the realization of a nation-wide infrastructure for a nation-wide EPR. This would require unique patient identification and unique identification of caregivers and health care organizations. A strong desire for regional integration of IS's could be seen. As a first step the exchange of prescription-information and the recording of medication were planned.

4.2 State of the art 2012

4.2.1 Observations and developments

The care card project failed around the time of publication. Main reason was the lack of functionality that could be agreed upon and, consequently, it did not deliver any value to the participants involved. A new program for a national information infrastructure was started, focusing on professional patient summaries for out-of-hours GP offices and on accurate medication lists. This program aimed at the provision of a national virtual electronic patient record, with the data remaining within the provider information systems, under the control and responsibility of the healthcare provider organization. The central infrastructure would then provide authorized healthcare professionals with logged access to these data. After lots of political pressure, often resulting in serious delays, the program seemed to take off in 2011 with just the two limited functions mentioned. However, at the last minute the senate voted down the law that would be the foundation of electronic health information exchange between healthcare provider organizations. It is uncertain whether the national infrastructure can be sustained on a voluntary basis without the foreseen legal and political support. Regional exchange initiatives have taken off in most parts of the country, often on the basis of Edifact technology. Regional organizations are taking the initiative to implement richer functionality, providing GP's with patient summaries in out-of-office hours, supporting referrals and systems for integrated care. Even though a national guideline for current medication lists has been adopted, the technology to enable a seamless exchange of medication data and, hence, error-free record of all current medication is still a major problem. The fact that electronic prescription systems will be mandatory as of 2013 does, not change this. Specific patient groups are supported by diagnosis and guideline based information systems for integrated care. The adoption of these systems seems to be closely linked to the financial reimbursement scheme that favors integrated care delivery. Unfortunately these systems do not integrate well with any of the current HIS or EPR systems. The successful implementation of an EPR depends on the quality of the implementation process (are end-users informed and involved) (Boll 2006), but even more on the perceived usefulness or micro-relevance of the EPR for end-users (Michel-Verkerke and Hoogeboom 2012). Micro-relevance refers to the degree to which the EPR solves the here-and-now problems of the end user and the value the EPR creates for the end-user (Spil, Schuring et al. 2006). The adoption of an integrated HIS/EPR system within healthcare organizations has had an impact on support for the care process in terms of care pathways, care plans, and guideline support. Quality measurement and reporting is often included in these systems.

Personal health records have not taken off at all, except for very specific patient groups, such as thrombosis or in vitro fertilization (IVF). Patient access to health data was only included in the national infrastructure as an afterthought. The sentiment has changed radically though, with patient empowerment and patient access being top of mind for developers and policy makers alike. Cross-functional care, have made the role of information and coordination along the care process increasingly important. The health profession has responded by developing guidelines for integrated care processes. And integral funding is established to finance multidisciplinary and cross-organizational care according to these guidelines. In his State of Healthcare report, the Inspector General has called for information standards to accompany these guidelines, in order to safeguard the exchange of essential data across all participants in the multidisciplinary health care process (IGZ 2011).

4.2.2 Results of interviews

Not surprisingly, the care process orientation is the focus of all interviewees, all being specialized physicians in the hospitals. Integration and availability of patient information are mentioned in almost all interviews (19 for integration and 16 for availability). Access to information from other physicians is often quoted: "A problem is incomplete information and not knowing what others are doing". Also, information from external sources, like GP's and other hospitals is required: "Information from other hospitals is often hard to get; it takes a lot of time and is therefore not requested most times". On the other hand: "It is quite normal that a patient will undergo the full set of diagnostics again, when referred to another hospital" even when full diagnostic information is provided. In this case the implementation of the EPR has not led to changes in the working processes. For another interviewee the EPR will be implemented to make changes of the care process possible: "the care process can be organized around the patient better. At the moment a patient has to return several times, because the processes are so slow." The mentioning of availability often comes from physicians where current (paper based) records are often not readily available. "Working in multiple locations is the most prominent reason for automation". Micro-relevance is mentioned by 18 out of 22 physicians. A very convincing argument in support of the care process orientation is the following: "[When introducing an electronic record] it is important that a wizard-like mode remains, much like the steps [in the process] that are now present on the [paper] forms". However, the implementation of an EPR changes the recording processes: "You have to learn the tricks, but you get your information faster" and "You need to think what you want in the [patient's] snapshot." Micro-relevance of an EPR becomes even more apparent when looking at the following two conflicting statements: "I want the patient histories to be shorter: just a summary of the most important information from the patient record, both from GP's as well as colleagues" versus "These are conclusions or summaries from the perspective of other specialists, whereas I need the underlying data [to draw my own conclusions]". Once familiar with using an EPR, specialists are no longer satisfied with just a replacement of the paper record. The EPR must also contain active elements, like decision support and workflow management incorporated in the EPR. "The electronic prescription system and the EPR cannot be separate systems, but need to be 100% integrated."

5 Medical Technology orientation

5.1 Situation 2002

The clinicians referred to the electronic access of radiological text and images as top priority request. The internet had changed the possibilities (Kahn, Leiner et al. 1997) and made the images available. The clinical laboratories could not accomplish their tasks without ICT. ICT was not only used for testing, but also for quality management, administration and distribution of the laboratory findings to the clinicians (Berg, Graaf et al. 2000). Anesthesiology and intensive care-units had also become high-tech environments, where ICT is an essential tool in the patient care. (Lundberg and Hanseth 2001) had not found any PACS and Radiology IS systems integrated with any HIS at a hospital in Sweden.

Their study illustrated however that the intranet applications had quickly developed into an essential part of the medical work practice. Standardization and web-technology would play a main role in the dissemination of these developments. Many Dutch initiatives made the examination results available inside and outside the hospital. IMS (Image Management System) was an example of a data warehouse from industry that was applied to a medical environment. Every authorized user could retrieve images from digital medical equipment. The Zouga-platform was an interface based on web-technology that gave access to several information systems. The project stemmed from the radiology-department and supplied physicians with patient data from the HIS, radiology images reports and medical literature (Ros and Heeten 2001). There were two main problems, the ICT for Medical Technology did not communicate with the administrative systems and in most cases the views could not be adjusted.

5.2 Status 2012

5.2.1 Observations and developments

The development in Medical Technology has been booming. Monitoring and imaging equipment have seen an unprecedented uptake, including image related technologies such as endoscopy and laparoscopic (minimally invasive) surgery. Even surgery robots are starting to be deployed on a regular basis. Although the dividing line between medical and information technology becomes ever more blurred, the integration between the two is still quite limited. Specialized applications are often needed to interface with a variety of medical equipment, such as Patients Data Management Systems (PDMS) for operation rooms or intensive care unit, electrophysiology interventions, or radiotherapy applications. Despite the lack of true interoperability and integration of administrative and medical technology, a large number of hospitals has decided to merge their information technology and medical technology departments. Their mutual dependence has grown so much that common management of the infrastructure is necessary. Almost all Dutch hospitals now have a PACS and Radiology IS with viewing capabilities integrated in the desktop of the clinician, often 'clickable' from the patient record in the HIS/EPR. However, the information flow in the opposite direction, from the HIS to the medical technology is often limited to administrative data. The IMS developments have not been successful, which has led to multiple imaging systems within one hospital for different types of images, such as endoscopy, anatomic pathology, cardiology and dermatology. The development of automated labs has led to a concentration of laboratory functions in one location for multisite hospital organizations and to standalone laboratory organizations serving multiple hospitals and other healthcare providers, including GP's.

Order management for both imaging and laboratory tests is taking shape, however the linkage with the EPR is still limited. It is often not possible to link the order to a treatment plan, or to include relevant patient data in the order. When radiology or pathology is not part of the hospital itself, it can become quite a (legal, privacy) challenge to grant access to the EPR to people outside the organization.

5.2.2 Results of the interviews

Out of the 22 interviewees, 16 mention the medical technology orientation of an EPR, always in conjunction with the care process orientation. Most of these refer to generic diagnostic technology, such as X-ray, CT and MRI images. However, some disciplines employ their own specialized medical technology, notably cardiology, pulmonology and, of course, anaesthesiology. This does not mean, that the desire for integration is absent: "You should not notice that you are in a different application. Also when you are viewing an ECG or chest x-ray". One interviewee states that his hospital has chosen a fourth generation EPR in order to be able to connect all available systems, including medical technology. However, this means that specialized EPR systems with tight and seamless integration to specific medical technology may not be available, as the hospital wide EPR system takes priority.

6 Discussion

6.1 What is the state of the art in the Netherlands regarding EPR's?

The minister of health announced that before 2004, the Netherlands should have a national EPR. However, in 2011 the Dutch Senate rejected the proposal for the nationwide-EPR-law, because of its concerns about privacy not being protected well enough. Kernel of the Dutch nationwide-EPR was the obligation for all care providers to connect to the national health-infrastructure. The infrastructure was already realized, and will possibly be used as a private service. The design of an n-EPR as an infrastructure, instead of software or a database, is typical for the developments concerning EPR's in the Netherlands in many regions. In this way information exchange between care providers in different healthcare organizations is facilitated and sometimes made more efficient and effective by replacing exchange of information by sharing information. The last ten years, many healthcare organizations have implemented an EPR in order to facilitate its care providers to share and exchange patient information within the organization or professional discipline, but also between organizations and across functional borders. Not only for care providing, but also to provide data for quality management, health inspection, finance and insurance company, without increasing the administrative burden of care providers. In all sectors of healthcare the number of implemented EPR's increases rapidly, and we expect that in a decade all care providers will use an EPR. The medical technology has strongly developed using ICT, however this development occurred independent from the development in EPR's.

6.2 Does the model need adjustments?

6.2.1 Consequences from the administration orientation: larger intersection administration and care process

The administrative requirements related to an EPR have increased dramatically over the years. From the very rudimentary level, of capturing the patient details and their diagnosis and capturing the relevant activities to a care-product based financing scheme, relating diagnosis and treatment to a specific tariff. The revenue of the healthcare institution is based on this tariff for every care-product they deliver and submit for reimbursement. Increasingly the quality and/or outcome of the treatment is taken into account as well. This means that from an administrative point of view the care-product that is being financed, needs to link with the care services that are being offered for patients. Such generic services are then personalized for the patient in a treatment or care plan, which guides the actual delivery of care, the documentation and registration of the activities carried out and outcomes achieved, and the reporting that is required by the government and/or the health insurance companies. The reporting of delivered care and the patient flow are increasingly subject to rules – including electronic formats - of government or insurance companies. That is why a connection with the environment is added to the administration orientation. Ideally, the registered data are used for evaluation also. This trend can be observed in all sectors of healthcare These developments create many relations between healthcare processes and administrative processes. That is why the intersection between the administration orientation and the care process orientation is made larger and becomes an integrative nature. Because of the close relation between administration and the care process, most care organizations prefer to have an EPR as an extension of their HIS. This creates a vendor-lock-in, especially for smaller organizations and home care.

6.2.2 Consequences from the care process orientation: external relations added to care process

The EPR must be accessible from outside the healthcare organization, for humans or other information systems. Especially in integrated care the EPR should support the cross-functional and cross-organizational collaboration by sharing information (Hofdijk 2011).

The development of telemedicine and self-management of patients make it essential that patients or the medical equipment they use, can enter and retrieve date. The national care infrastructure connects EPR's from healthcare organizations. An external connection is therefore added to the model. The exchange of information is regulated by legislation. Unfortunately the present legislation is not fully adequate for electronic information exchange. The Council for Protection of Personal data (CBP: College Bescherming Persoonsgegevens) publishes its interpretation of the present laws and gives instructions how to deal with electronic information exchange.

6.2.3 Consequences of the medical technology orientation: interfaces with medical technology

The medical technology orientation has developed in itself. Medical technology offers interfaces to give access to the produced data, not only to care providers inside the organization, but also to doctors outside the hospital, like GP's. Therefore also in the medical technology orientation a connection to the environment is added. The intersections with the other orientation are restricted to interfaces to exchange data for humans and information systems. No real integration is expected.

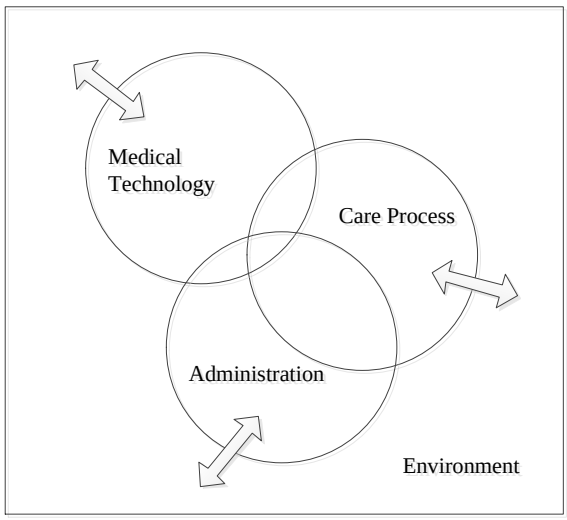

Figure 2. The updated EPR-orientation model

Figure 2 depicts the updated EPR-orientation model with a larger intersection between the administration and care process orientation, and a relatively small intersection between the administration and medical technology orientation. The relation of each orientation with the environment is added.

6.3 When will an EPR be successful?

In order to be successful an EPR must offer the end-user an integrated view on all orientations and the environment, independently from which orientation the EPR stems. In 2002 we formulated four criteria an EPR must fulfil in order to accomplish this. From the developments in each orientation we find support for these criteria and additional information. The first criterion was, that the EPR must be relevant to the end-user (Schuring and Spil 2001), i.e. solves the end-user's present (actual) problems, and supports the end-user's tasks (Garrity and Sanders 1998). From the care process orientation can be learnt that individual care providers will only use an EPR when it supports them in their effort to provide good quality care. The analysis of interviews shows that micro-relevance can be inferred from 18 out of all 22 physicians. The four physicians to which micro-relevance does not seem to apply, however, do indicate that integration and availability are important. These interviewees see the EPR mainly as a generic source of information and seem to regard lack of this information as a fact of life.

One of them even states: "When a surgeon stores everything in the system, he writes his own statement [for the disciplinary court]".

The second criterion was, that the EPR must store complete patient data, which means it stores all data at a patient level in a retrievable and integrated form for any patient (Drazen, Metzger et al. 1995). From the care process orientation can be learned that in order to be complete, an EPR must offer an integrated view, since many information systems are developed and the care provider does not want to log in and out for each medical problem or patient. Connectivity and interoperability are essential for adoption. The integrated patient data criterion is mentioned in 19 of the interviews. Quite a few striking remarks are made on the cultural change such an integrated record brings about: "When viewed from the perspective of an individual doctor, he is put into a straightjacket; however, from the patient perspective, adequate information is made available"; "It is not my system, the system belongs to all of us".

Making information available to relevant caregivers (Drazen, Metzger et al. 1995) was the third criterion. In 2002 we mainly referred to 24x7-access to the computers in the organization's network. Nowadays in integrated care a strong need exists to have access to EPR's from other healthcare organizations (Michel-Verkerke, Schuring et al. 2007). Another aspect of availability is mobile access anywhere, anytime, at the bedside, at the home of the patient (home care), or anywhere where the patient or care provider is situated, provided that the access is safe and secure. From the developments in the medical technology orientation arises the need for interconnectivity between medical technology and information systems in other orientations, which is essential to establish integrated views for the care providers, but also to provide users of the medical technology with patient information. The need for patient information to be readily available is paramount from 16 of the 22 interviews analyzed. This includes the notion, as mentioned previously, that having to make patient records available across multiple locations is a main driver for the implementation of and electronic system. It seems that the physicians that do not indicate availability of patient information to be a key criterion, perceive a patient record in a very literal sense: a tool to record information after the fact. The last criterion was, that the EPR must be "active", i.e. data are not only showed in a passive way, but intelligence is added, such as medical alerts, a prescription system, and medical protocols. (Atkinson and Peel 1998; Safran, Sands et al. 1999). Most EPR's in 2012 have active elements such as:

a. medical alert when (lab-)results or measurements are too high or too low
b. prescription: medication list, interactions, contra-indications
c. care protocols for chronic diseases (decision support) (Cleveringa 2010)
d. workflow management (as element of clinical path or care protocol),

Decision support and workflow management, based on care protocols are the key features of information systems for integrated care (Cleveringa 2010). Even though care protocols are often mentioned, only three of the interviewees indicate that they would value an "active" role of their (future) EPR. All three physicians were already using an EPR at the time of the interview, which may have influenced their perception. One of them, interviewed in 2011, was already using an advanced EPR that provided such "active" functionality. Without having integrated patient data, it is probably hard to imagine the added value of active elements, since the main concern is getting access to the patient data and making the inferences on reference levels, drug-interactions and protocols yourself.

A new criterion arises from both the administration and care process orientation. Delivered care must be automatically linked to a care product in the administration in order to be able to bill or declare costs. And it must be possible to derive indicators for quality of care and management information from reporting of care, in order to fulfill regulations, without increasing the administrative burden of care providers (Hofdijk 2011). Only two of the interviewees indicate that such linkage between patient data and quality and finance reporting is needed. One of them is specialized in diabetes, for which quality reporting requirements exist for over two decades already. The other one is, again, the physician using an advanced EPR, which helped to bring down the fall-out in the billing process considerably. Other physicians are probably not even aware of some of the reporting that is being done on the basis of their patient data.

When these additional requirements are integrated in the requirements listed in 2002, we come to the conclusion that an EPR can be considered to be successful from a user's viewpoint when it results in, or contributes to an EPR, that:

1. Is micro-relevant to the end-users
2. Provides complete and integrated patient data
3. Is available and accessible anywhere and anytime
4. Contains active elements, like alerts, decision support and workflow management
5. Registers data necessary for quality and finance, without extra effort for the care providers.

7 Conclusion

Our hypothesis was that in order to be successful an EPR should be located at the intersection of the EPR-orientation model. What we see now is that most EPR's originate from the administration orientation and offer an EPR-module that supports the care process rather well, but integration with medical technology is not realized. However, data from medical technology are disclosed through an interface with the administrative system (HIS). In the model this development resulted in a larger intersection, with an integrative nature, between the administration orientation and the care process. Another development is that an EPR must have connections with the environment in order to support cross-functional and cross-organizational care, and provide the environment with information to account for quality, finance and legal issues. The requirements for an EPR to be successful are confirmed and extended with the need to register indicators automatically. In order to meet the requirements the EPR has to be on the intersection of the three orientations. This does not mean that the EPR has to contain all information systems from these orientations, but has to disclose the information systems in these orientations and has to communicate with these systems in a way that the end-user experiences no thresholds. The EPR has become an essential part of healthcare and is adopted by many care providers. The model and requirements we presented in 2002 gave a good indication for the developments of the last decade. However, the reality was more complex, as could be expected.

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