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From a paper-based transmission of discharge summaries to electronic communication in health care regions

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Summary
Objectives: In Austria, the general practitioner (GP) is the first point of contact for persons with health problems. Depending on the severity of the person's medical condition, a GP may refer her or him to a secondary care hospital consultant, who reports findings back to the GP in form of a paper-based discharge letter. Researchers report that paper-based communication of medical documents between different health care providers is insufficient in quality, error prone and too slow in many cases. Our aim was to develop and to realise a strategy for a stepwise replacement of the paper-based transmission of medical documents with a distributed, shared medical record.
Methods: In the first step of a three-steps strategy for development of a consistent, comprehensive and secure regional health care network, an electronic communication of discharge letters and diagnostic results between existing information systems of different health care providers in Tyrol, Austria, has been established: in the form of cryptographically signed S/MIME e-mail messages and, additionally, via a secure web portal system. In two further steps, an extension of the system by a bi-directional communication and by improvements of the web portal system is planned, leading to a comprehensive electronic patient record for shared care.
Results: After realisation of step 1, in October 2004, about 3500 electronic discharge letters were sent out from the Innsbruck University Hospital (IUH), which represents about 8% of the total number of discharge letters of the IUH. In addition, a lot of feedback was received and legal, organisational, financial and methodical difficulties were overcome.

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Discussion: The stepwise approach to replace paper-based with electronic communication in the first step was helpful, since knowledge has been gained and cooperations were formed. For the realisation of a distributed, shared medical record (steps 2 and 3), it will not be sufficient only to replace paper-based transmission of medical documents with electronic communication technologies, but in the further steps, organisational changes will become necessary. As well, legal ambiguities must be resolved before a distributed medical record for cooperative care, used by several institutions as well as by patients, could be established.

1. Introduction

In Austria, the general practitioner (GP) is the first point of contact for persons with health problems or medical requests. Depending on the severity of the person's medical condition, a GP may refer her or him to a secondary care hospital consultant. Therefore, a GP hands out a summary of current complaints and past illnesses to the patient, who forwards it to the consultant. On the other hand, the consultant reports findings back to GP in form of a discharge letter. Researchers report that paper-based communication of medical documents between different health care providers is insufficient in quality, as well as error prone and often too slow [1,2]. Many publications have suggested positive effects of electronic messaging [3]. Although computer-based information and communication tools have been used in health care facilities for several years [4], and the use of electronic medical records (EMR) within health care enterprises is already a common and well-appreciated practice [5], the communication of discharge summaries and diagnostic results is mainly paper-based. Seamless sharing of multiclinical information is a fundamental requirement for achieving continuity of care [5]. More information processing towards patient-centred, shared care might better support high quality as well as efficient health care [6].

A research project has been started in 2002 in pursuit of the replacement of this error-prone, quality-deficient and slow paper-based communication with electronic transmission in a standardised and secure way. The aim of this paper is to report on this approach and experiences with it.

2. The information system of the Innsbruck University Hospital

TILAK (''Tiroler Landeskrankenanstalten'') is a publicly owned holding company in Tyrol, Austria. It has six hospitals (approximately 2300 beds, a staff of more than 6000 persons, including more than 1000 physicians), among which the Innsbruck University Hospital (IUH) is the largest, with approximately 1520 beds and approximately 4700 employees. Each year approximately 70,000 inpatients and approximately 300,000 outpatients receive medical treatment in the IUH. As well, more than 400 medical students are admitted to start with their studies at the Medical University. Its mission encompasses patient care, research and education, and involves a wide spectrum of sophisticated medical specialties. With the development of an enterprise-wide integrated hospital information system, the path to a comprehensive electronic patient record, which is ubiquitously available throughout the TILAK hospitals, was introduced early [7,8]. However, discharge summaries, images and diagnostic results could not be transferred to other health care providers electronically. They have to be printed out and sent via conventional mail. Changes in format, with all the disadvantages of transcription, occur. As written in the TILAK IT-Strategy 2003—2007, one of the objectives of the TILAK hospitals is to replace the paper-based communication by electronic communication to better support cooperative care [7].

3. Strategy: electronic communication of medical documents between different health care providers

To replace the paper-based transmission of documents in the Tyrol health care region, which would eliminate the changes of format in transfer of medical documents to other health care providers, a strategy for a stepwise implementation, which encompasses the completion of three steps in total over a period of 5 years (2002—2007), has been worked out (Fig. 1).

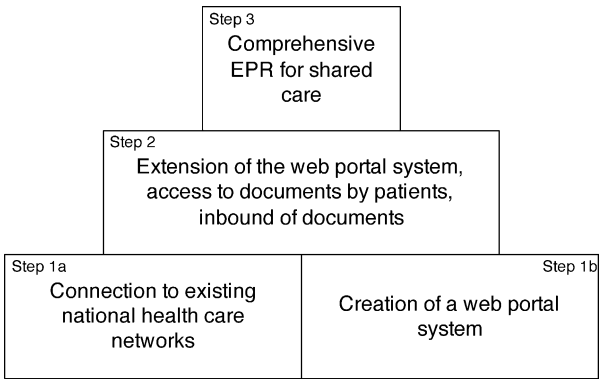

Fig. 1 Three-steps strategy for electronic communication of medical documents between different health care providers in Tyrol. The first step includes the connection of the TILAK hospitals to existing national health care networks in Austria (step 1a) and the creation of a secure web portal system (step 1b), both for a mono-directional communication of discharge summaries from TILAK hospitals to other health care providers. Step 2 comprises an extension of the system by a bi-directional communication and by improvements of the web portal system (which have to be systematically evaluated), leading in step 3 then to a comprehensive electronic patient record for shared care. For more information, please refer to the text.

4. Realisation: implementation of electronic communication of medical documents between different health care providers in Tyrol

For realisation of the presented strategy, the project health@net was started in May 2002. In October 2004, the implementation of step 1 was nearly finalised and the preparations for step 2 have already begun.

As step 1, an *electronic transmission system* for medical discharge summaries has been developed (see Fig. 1 for an overview).

4.1. Step 1a—connection to existing health care networks

In Austria, several commercial health care network providers for communication of medical documents exist. GPs, who are participants of this networks (this information comes from a central GP directory, which is held by the Austrian Medical Association; about 22% of Austrian GPs are members of these health care networks), are able to receive discharge summaries in the form of cryptographically signed S/MIME e-mail messages (according to the UN EDIFACT standard). They can directly and automatically import these documents into their GP system (push of data), which is the main advantage. The disadvantage of this communication path is that participants can only receive discharge summaries in EDIFACT-format (only plain text without any layout).

In order to support this way of transmission and connect TILAK to these networks, a gateway server was installed. Since June 2003, more than 40,000 medical documents in total were sent out electronically (approximately 6—8% of the documents which were sent via conventional mail).

4.2. Step 1b—creation of a web portal system

All physicians, whether they are members of commercial health care networks or they are not, were offered access to a secure web portal system.

Therefore, copies of the electronic documents produced at the participating TILAK institutions are posted to a specialised document management system. A secure web server (SSL/TLS) accesses these documents and makes them available to authorised users. A restrictive user management system regulates access to this sensitive patient information. The advantage of this communication path is that participating physicians not only can receive discharge summaries in PDF (better data presentation than EDIFACT) and EDIFACT-format (for import into GP systems) but also images and multimedia content to their patients.

The implementations of step 1b can be seen as a stand-alone electronic document communication system for physicians, who are not participants of a commercial health care network (with disadvantage of manually access of data from a web portal system, which means additional work), or as an add-on for physicians, who are members of these networks (they can receive EDIFACT documents automatically via these networks and benefit from additional multimedia data and better data presentation).

Physicians, who are not members of national commercial health care networks nor have access to the web portal system, receive discharge summaries of their patients — as in the past — paper-based via conventional mail.

The information, whether a GP is a member of a commercial health care network, has access to the web portal system or can only be reached via conventional mail, is stored in flags of the clinical information system (CIS) user database. So the decision, which communication path to be used for transmission, is made automatically by the CIS, when some documents have to be sent (Fig. 2).

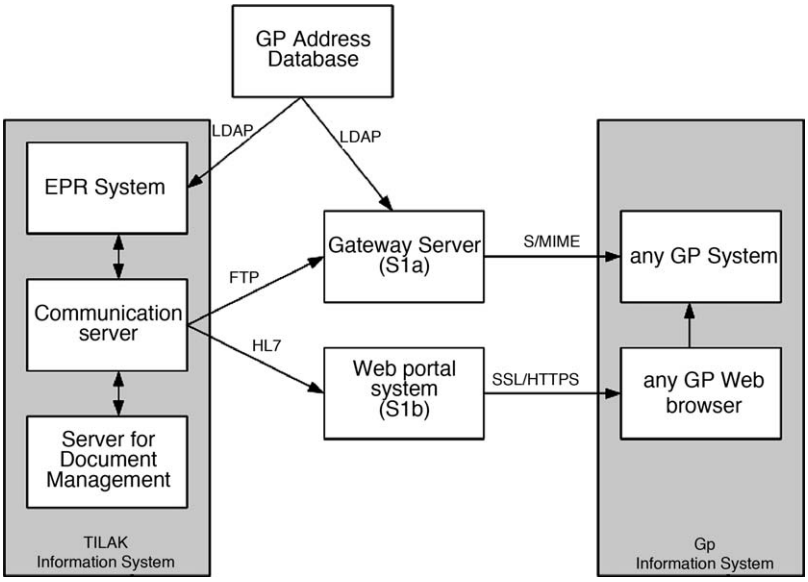

Fig. 2 Logical tool layer of a three-level graph-based meta model (3LGM [12,13]) of relevant system components. Medical documents from the electronic patient record (EPR) system are addressed to their receivers (according to the GP Address Database, an LDAP address directory which is held by the Austrian Medical Association) and transferred either to a gateway server, which delivers the documents directly into an inbound directory of the GP system over the commercial health care networks (step 1a), or onto a server for document management, which provides the files for a secure web portal (step 1b). For more information, please refer to the text.

4.3. Steps 2 and 3—extension of the web portal system leading to a comprehensive EPR for shared care

The plans for these project steps are preliminary and include expanding the web portal system created in step 1b. In our vision, on the one hand, an improved user management system should empower patients to access their medical documents. On the other hand, implementations for a bi-directional communication with the GPs are planned. The vision for step 3, which lies several years ahead, is to create a comprehensive and consistent electronic patient record for shared care, which can be distributed over various participating medical institutions [18], using techniques to display data as required for a specific use case or user.

5. Results

Between June 15, 2003, and October 31, 2004, a total of approximately 40,200 discharge letters were sent out electronically. Due to an increasing number of participating departments within the IUH during this time period, the number of electronic discharge letters per month was increasing. About 6—8% of the total amount of discharge letters was sent out electronically during August—October 2004 (Table 1).

We will now summarise in detail some technical and organisational experiences.

When we started to send documents electronically, we discovered some LDAP related problems concerning the GP address directory from the Austrian Medical Association. Outdated and partly cor-

Table 1 Analysis of the gateway server logs (electronic discharge letters) and reports from the mail office (total discharge letters) of the IUH

Month	Electronic discharge letters	Total discharge letters	Electronic/total (%)
August 2004	2700	44000	6.13
September 2004	2952	42000	7.03
October 2004	3514	42000	8.36

The table shows absolute and relative numbers of electronic discharge letters in relation to the total amount of discharge letters of the last 3 months. Medical professionals, who are not able to receive electronic discharge letters, get them paper-based via conventional mail. For more information, please refer to the text.

rupt data lead to excessive transfer errors in the send-processes. During the test period, we had a good collaboration with the Austrian Medical Association for solving the problems. Most of the errors were eliminated and the quality of the address data reached an acceptable level, so the system now represents a usable public key infrastructure (PKI).

Although all transmitted documents are encoded in the UN EDIFACT standard (slightly modified by the Austrian Medical Association), many GP systems had problems with data import caused by a different understanding and different implementation of the EDIFACT standard in various GP systems. Fortunately, we had a good cooperation basis with most of the GP system producers and the problems were eliminated.

However, some hospitals in Austria are able to send medical documents electronically, they currently cannot receive electronic documents. Every health care provider uses its own patient index. The automatic insert of received documents into the electronic patient record of a special health care provider is not possible.

Some health care providers are apprehensive about electronic transmission of documents. Four GPs in total did not want to receive documents electronically at all, even though they are members of commercial health care networks. In addition, the psychiatric ward declined an electronic transmission of their discharge summaries because of the extremely high sensibility of the data.

6. Discussion

The discharge letter is an important clinical document for hospitalised patients. It is used to inform the patient, the general practitioner and other professionals involved in the patient care [9]. Although the TILAK hospitals in Tyrol, Austria, developed an enterprise-wide integrated hospital information system with a ubiquitously available comprehensive electronic patient record throughout the TILAK hospitals [7,8], discharge summaries, images and diagnostic results could not be transferred to other health care providers electronically. They have to be printed out and sent via conventional mail. Paper-based discharge letters are insufficient in quality, as well as error prone and often too slow [1,2], and many publications suggest positive effects of electronic messaging [3].

The stepwise approach described in this paper leads from a replacement of the paper-based transmission of discharge letters with electronic transmission, and further to a patient-centred electronic health record for shared care, over a time period of 5 years. The advantage of this procedure is that one may learn, and the results and experience from earlier steps can be used to streamline the later steps. Due to the lack of common standards for a comprehensive electronic health record for cooperative care, and due to some legal issues, this approach has already proved its worth.

Through the health@net project, improvements in quality and efficiency in the regional health care of Tyrol are expected. A fast, comprehensive and secure exchange of medical documents (images, discharge letters as conclusions of medical treatments) over the World Wide Web between general practitioners and hospitals should lead to a reduction of costs, time, redundant medical services and, ideally, the duration of treatment. The advantages for patients are that physicians and institutions participating in the shared care process will have access to the patients' relevant health information more quickly, and medical decision processes may be accelerated [15]. A cross-institutional access to health-relevant information makes medical decision processes faster and thus directly affects the quality of patient care [10]. An evaluation of acceptance (survey) and costs has been recently carried out. The results of the acceptance study show overall high user satisfaction with the electronically received information. Also, the results indicate that user support should be improved and some adjustments on structure and layout of the electronic letters were to be discussed, representing more an organisational than a technical problem [19]. The evaluation of costs shows that the reduction of costs by the replacement of paper-based with electronic communication amortises the project costs already within 1 year.

Although many related international projects are following similar objectives, a comparison is difficult because the starting positions of institutions in health care regions are different. ''Personal health link'' from Kaiser Permanente [16] is limited to a very small group (which may extend in the future, but this information is not given) and provides a communication solution between doctors and patients. Doubtless, such a system could improve the relationship between patients and doctors, and may increase the compliance. But using this system could mean additional work for physicians. Also, the literature shows that patients who have access to their medical records need appropriate support [11]. ''My Patient Charts'' [17] is designed differently. It acts as a full web-based outpatient system. Doctors can set up patients in this system and enter medications, complaints, laboratory results, etc. Even billing can be performed with this system. But a transmission of documents and communica-

tion between different facilities to support shared care is not possible. ''PICNIC—Professionals and Citizens Network for Integrated Care'' [14] from the Danish Center for Health Telematics together with regional health providers, technology centres, industry and universities in nine EU countries, aims to support the regional health care providers in the implementation of health care networks. PICNIC provides open source components for web services along with an architecture for regional health care networks, which is similar to the architecture of health@net step 1a.

The lack of standardisations is not the only common problem. Therefore, an interesting approach is described in [9]. There are also legal, organisational, financial and methodical difficulties. Since medical data are strictly confidential, strong emphasis has to be placed on data protection. Cooperation between patients and different health care institutions assumes transparency in treatment processes. But transparent data could be misused and therefore the privacy of patients or also physicians could be harmed. The Directive 95/46/EC of the European Parliament on the protection of individuals with regard to the processing of personal data provides safeguards for the handling of sensitive data. Article 8 provides that the use of sensitive data shall be prohibited unless at least one of a number of conditions is satisfied. Such conditions include: where the individual has given his or her explicit consent [20].

It is not sufficient to ensure only the security of the data. Medical data are strictly purpose-bound. Embracing organisational and technical arrangements have to comply with national and international legal restrictions and have to avoid misuse of data.

This lack of standardisation and organisational problems also affect security related aspects. At this moment, useful or even required measures such as secure authentication and advanced access control were only partly implemented. Heterogenous tools with different levels of interoperability complicate the implementation of an end-to-end security concept (a too strict security policy would exclude many potential participating users and impinge on the realisation of our vision—a distributed medical record for cooperative care). In future steps of the heath@net project—particularly when inbound traffic will occur and distributed architectures will be implemented, a comprehensive security concept will be required to serve the needs of data protection.

During the implementation of step 1, we experienced that organisational problems outweighed technical difficulties since it is not sufficient to replace paper-based transmission of medical documents by electronic communication technologies. Many organisational changes will become necessary (i.e. workflow in document creation, responsibilities, support in case of transmission failures and requests of different health care institutions or even patients, etc.). See also [19] for evaluation results.

Many questions are still open, but we are confident that solutions will evolve in the next years and problems can be solved.

7. Conclusions

Through the realisation of our approach for a transinstitutional information system architecture, improvements in quality and efficiency in the regional health care of Tyrol, the western part of Austria, are expected. The fast and comprehensive transmission of medical documents between general practitioners would lead to a reduction of costs, time, redundant medical services and, ideally, the duration of treatment. Persons participating in the shared care process will have access to the patients' relevant health information more quickly, and medical decision processes may be accelerated. The cross-institutional access to health-relevant information makes medical decision processes faster and thus directly affects the quality of patient care [10,11,18].

To measure and quantify the improvements in quality and efficiency, evaluation studies have been performed and a summarisation of the results is currently carried out.

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