

## MANAGEMENT OF MEDICATION KNOWLEDGE IN SIX FINNISH PRIMARY HEALTH CARE CENTERS

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### ABSTRACT

This paper discusses the role of knowledge management in healthcare organizations. We utilize the 7C knowledge model to evaluate the knowledge creation of medical staff in the case of managing medication information. A field study was conducted in a Finnish municipality by interviewing physicians and nurses about the acquisition and utilization of medication information. The results suggest that current tools for managing medication information do not provide much support for new knowledge creation. The tools are merely seen as operational tools for delivering care. Based on the results improvements on the healthcare information systems are suggested.

### I INTRODUCTION

Healthcare is an information intensive sector. However, despite the capacity to create knowledge necessary for delivery of care services, there is a lack of knowledge management and therefore, the “knowledge assets” are not realized with their full potential [14]. Although an effort has been made to conceptualize and operationalize knowledge in the healthcare environment (e.g. [1]) little effort has been made to evaluate the existing information systems in the healthcare in the light of their ability to create organizational knowledge.

One aspect to look at medicine is to see it as an old discipline, where the amount of cumulative knowledge is already rather extensive [13]. However, health care organizations have to reinvent their organizational procedures on a continual basis, and knowledge needs constant maintenance. Especially, each patient case is always new and unique, and maintaining and updating the data around the patient, including the medication information, is a heavy task.

The purpose of this article is to explore the knowledge creation, especially in the case of medication information in the primary care unit in Finland. Using the 7C model [8] as a theoretical framework we evaluate the current state in the use and acquire of medication information in a Finnish primary care and discuss how the information systems currently facilitate the organizational knowledge creation.

In the healthcare literacy, there are many different medication-related terms. *Medication knowledge* is defined as the knowledge about the name of the medication, dosage and how to take it. Medication knowledge also includes high correlation with medication adherence [2]. However, medication knowledge can also refer to common knowledge on certain drug, and not the personal medication regimen of

the patient. The term *medical knowledge* is also sometimes used as described above (e.g. [4]). *Drug information* contains among other things information on interactions, guidelines, pregnancy warnings and nursing warnings [12]. Because of the variation of the term *knowledge*, in this article *medication information* is used to describe the personal medication regimen of a patient. Medication information is defined as the generic and commercial name of the drug, the dosage and the use indication.

Our paper discusses the knowledge creation between professionals at an organizational setting. However, we must remember that for the successful care, the joint knowledge creation between the medical staff, the patient him/herself, and the family and other members taking part in the care process, is of crucial importance. This discussion is not, however, taken up in this paper.

The paper is structured as follows: First, the theoretical background of this study, the 7C model, is presented. Second, the field study is introduced with its methodology and case description. Then, the results of the analysis are presented using the classification basing on the 7C model. Finally, discussion and conclusions are provided.

### II UNDERSTANDING KNOWLEDGE MANAGEMENT PRACTICES

To analyze the current information systems to manage medication information we used the 7C model [8] as a theoretical framework. The 7C model suggests that the following seven Cs play a critical role in the creation of organizational knowledge: Connectivity, Concurrency, Comprehension, Communication, Conceptualization, Collaboration, and Collective intelligence. In the 7C model the integration of individual and social orientations is emphasized, and knowledge is assumed to be created through interaction between tacit and explicit knowledge.

The framework assumes that *connectivity* of all stakeholders with the joint information space and with people potentially *concurrently* is provided in a technologically sound manner, e.g. through the Web, Internet, wireless, mobile and other technologies. These may promote options and allow freedom of choice with contextual support, providing users with a rich environment for *comprehending* and *communicating* the information they find. Knowledge is *conceptualized* as artefacts, which serve as a vehicle for *collaboration* through interaction between information producers and consumers, within a team of co-workers or among other stakeholders. All of these six preceding Cs

contribute to the growth of *collective intelligence*. The creation of organizational knowledge is not a linear process, but rather a multi-cycle spiral process [8].

The four central sub-processes in knowledge creation are comprehension, communication, conceptualization and collaboration. Comprehension is a process of surveying the external environment and interacting with it. In this process the intelligence is integrated with other project knowledge to identify problems, needs and opportunities, embodying explicit knowledge in tacit knowledge, "learning by doing", and re-experiencing. Communication is a process of sharing experiences between people and creating tacit knowledge resulting decisions with other project knowledge on an ongoing basis. Conceptualization refers to a collective reflection process in which tacit knowledge is used to form concepts and justification and to systematize these into a system of knowledge. The products of this process are knowledge products of a project team and they form a more or less comprehensive picture of the current project. The products could be including proposals, specifications, descriptions, work breakdown structures, milestones, timelines, staffing, facility requirements, budgets, etc. Collaboration is then supposed to be a true team interaction process in which the resulting conceptualizations are used within teamwork and other organizational processes. The collective intelligence is the aim of the process and its growth is the outcome of the going through these phases in a seamless and spiral-like way. [8]

In the case of medication information knowledge creation is understood as both the increased understanding of the medical condition of an individual as well as an increased understanding of the processes and procedures in medicine and in the organisation in hand. By medication information we mean the simple information such as the drug, dosage, indication etc. whereas by medication knowledge we mean the understanding of the medication processes and professional knowledge.

### III STUDY METHODOLOGY

We examined primary care units' situation in acquiring and using patients' medication information by employing qualitative methods both in collection as well as in analyzing the data. Semi-structured interviews were used to identify how medication information was used and acquired and, more specifically, how the current information systems supported knowledge creation both inside and beyond the organization borders.

All together six primary health care centers participated in the study. The subjects of the field study were physicians (5) and nurses (5) each of whom were using medication information in their work. Since the creation of knowledge is not bound to a certain professional group, the both main professional groups were selected as the subjects of this study.

The collected data was analyzed using the framework known as the 7C model for organizational knowledge creation

[8]. Transcriptions were written down based on the interviews and the texts were analyzed through the themes described in 7C model.

### IV RESEARCH CONTEXT

The hospital districts in Finland are usually municipal federations consisting of one main hospital and several regional hospitals. In the same region, there are also various health centers required by law to offer comprehensive primary health care services to the population of the municipality or another fixed area [3]. The Finnish healthcare system is financed by two main mechanisms. About 70% of expenditure goes on services provided by municipalities. In addition, the National Health Insurance scheme reimburses part of the costs for clients who use private health services. Public health services provided by the municipalities are financed by municipal taxes, state subsidies and user charges. [10]

Electronic patient records (EPR) and other information systems are already widely in use in primary care units and many special health care units are about to start implementing them. The electronic transfer of the patient and medication data between different units has been relatively efficient but further developments are still required. At the moment, patient information systems vary between different hospital districts and electronic data transfer between them is cumbersome. Some of the hospital districts have recently renounced using their current patient information systems and they will try to manage without any information system that facilitates the transfer of data electronically between two different units in the hospital district. Nevertheless the goal is eventually to collect the entire patient data in one, national archive that makes it possible to create smooth service chains on the national level [9]. The national patient and medication database is still under planning and, in the worst case, it could take years before it can be implemented efficiently [5].

Two EPR systems used in the Finnish primary care cover together 90% of the market share. The most commonly used EPR in the primary care is called Effica [15]. The field study organization (the primary healthcare within one municipality in Finland) is using an EPR which is supposed to include all the information about a patient's health and treatment. Technically this system is based on a client-server architecture. The core of the system is a database where all the information is stored. The user interface and the functions are to a large extent similar to the former paper-based system. The system consist on the core information and the basic level reports. The core information is the summary of the essential information concerning a patient's health and treatments (e.g. the cause of treatment, the main goals, the methods, the epicrisis etc.). This information is general in nature and not restricted to a certain field of expertise in medicine. On the contrast, the basic level reports are wider and more specific descriptions about for instance, treatment plans and they are normally written down by a specialist.

The process of managing medication information from an individual professional's perspective includes the healthcare professional to acquire the needed information about the medication of a patient. Secondly, information is processed, i.e. it is used to form a picture of the current state of the patient's medications, the dosage, etc. This information is processed into the knowledge and used to provide the medical treatment. Finally, the last phase is the information sharing which means that the professional adds to the current information the information that he/she acquired during the processing of the existing information and through that increases the knowledge of the organization. The process of medication information acquiring and use is presented in Figure 1.

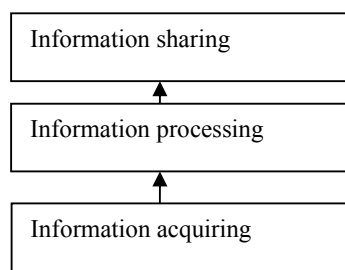


Figure 1 Process of medication information acquiring and use

Based on the interviews the information was acquired from several sources. The most important source was often named to be the patient him/herself. Other important sources of medication information were the EPR, paper achieves, patient's own 'book-keeping' of his/her own medications (e.g. lists, piles of prescriptions etc.). Sometimes the information is collected by contacting other healthcare organizations (such as those in different municipalities that are not connected to the EPR in this municipality).

Information processing was in general not seen problematic presuming that the previous phase in acquiring information has been successful. For processing information, the respondents used mainly their professional knowledge but also different electronic support tools (such as pharmacological encyclopedias) were used.

Information sharing takes place during or after the patient consultation. Normally, in the case of physicians the prescription of a new drug is entered in the system at the same time as the prescription is written to a patient. However, this prescription information often is insufficient and lacking for instance, the indication or the dosage of the prescribed medication. Another problem is the lack of time to share the information properly. Physicians and nurses often have very tight schedules and therefore, the registration of the patient information can happen negligently.

## V RESULTS

### A. Connectivity

The current EPR connects the healthcare employees of a single municipality's primary healthcare. If a patient visits a primary healthcare center in the same municipality all healthcare professionals have an access to his/her patient information. To access information in other units such as special healthcare units or the private healthcare sector units more effort is required. For instance, if a patient moves from another municipality the patient information, including the medication information, will be posted to the new municipality but only with patient's explicit agreement. The private healthcare units are not connected to the system even though they often are geographically very close.

One critical problem the interviewees expressed was the lack of common system between the primary healthcare and the special healthcare. Although an epicrisis from a special care unit within the same municipality is transmitted to the primary care centers, this is conducted with paper or with another information system. This made it very complicated.

In primary care the interactions that require access to medication information take place in consultation rooms all of which have an access to the EPR and other related programs. Therefore, there was no need to access these systems, e.g. via mobile user interfaces.

This might, however, not be the case in homecare or mobile working environment. It is important to have all the information up to date, and the use of practical mobile user interfaces could facilitate the work of primary healthcare centers in such a way that the information would in up to date for instance after a home visit.

### B. Concurrency

One potential problem from the concurrency point of view is the dictation process. Oftentimes physicians only dictate the statements rather than type it into the system. In these cases there is often some lack in between the dictation and its entry in the system.

In general, extensive documentation is used in health care in order to avoid the problems of needing concurrent attention. However, there seems to be some evidence that the industry is lacking both devices as well as the culture for concurrent communication between different professional groups.

### C. Comprehension

The process of surveying and interacting with the environment is enabled via the interaction database. This database contains information about possible drug interactions (i.e. if some drugs have unwanted effects with some other drugs). This should help the physicians in

comprehension as it is probably impossible to know all the possible drug combinations by heart.

The system allows professionals to add pop-ups for individual patient information providing details about important things concerning his/her treatment. This provides important information for other healthcare professionals to conduct their work and by examining the pop-ups and other related patient information the physicians may indeed comprehend something new in conjunction with individual patients and/or reflecting it more generally.

Individual physicians may read the core information sections as well as the basic level reports from the system. Especially the basic level reports are often useful as they are not as structured as the core information sections and, therefore, they facilitate the storing of more specific, freely expressed information. Accessing this information might help in comprehension as this "freely expressed" information might include some traces of the tacit knowledge [7]. However, it was also seen as a problem that there was no common well-established procedure for filling in the information. This was, according to some interviewees a big problem, since it made it very difficult to find the needed information.

Comprehension of medication information can be harmed through information overload, which can become a severe problem in health care settings, too [6]. The total volume of data of a long-term patient can be overwhelming.

#### *D. Communication*

The system allowed some interaction with the database but it was not interactive; it does not support an individual physician to share his/her findings or best practices. According to the 7C model, this is a serious drawback as the process of communication should be about sharing experiences (e.g. best practices).

The current information system supports to some extent the communication between healthcare professionals. For instance, there are pop-ups in the EPR that indicate the most important or risky aspects concerning a patient's medical condition when the system is opened. However, the respondents claimed that there are often too many pop-ups and as the time is limited and in many cases the information in the pop-ups does not concern the problem at hand and the windows are just shut down without going deeply in the provided information.

Another problem in supporting communication is that different professional groups have different rights to the use of the system. For instance, the respondents had faced with problems in finding and accessing information that was administratively under the home care sector.

The system allows information to be written to the basic level reports at least. Writing these reports should help communication to some extent as they enable sharing of information about a patient's treatment.

#### *E. Conceptualization*

In the current EPR there is a so called medication list which should include all the information about the current and previous medication. However, some of the physicians use patient basic level report in writing the prescribed medication. There is no defined way in which the medication information should be included in the reports. This is actually a big obstacle for shared understanding as the staff may have to look the medication information from different places. Indeed, the respondents indicated that finding where the information is located was problematic. Also in many cases the form and content of the information varied which might also be a hinder for conceptualization. For example, it can be crucial to know the indication why a certain medication was prescribed since there are drugs that can be prescribed for several different reasons. However, there is no single way of formulating such information in the system. Although the term of medication information was relatively clear to all of the respondents, the current information system can not be said to support the common understanding of the concept.

However, it should be noticed that the concept of "prescription" is very strong in the medical field. The meaning and structure of a prescription is clear for all stakeholders in the health care process. However, the strong position of prescription also seems to inhibit the development of new needed concepts. It is a rather isolated concept, and there is a need for concepts that would rather address the whole medication palette of a patient.

#### *F. Collaboration*

Although the current EPR makes it possible to collaborate by sharing the information about medication or providing pop-ups or more specific descriptions about the treatment in the basic level reports it does not provide a platform for a truly collaborative work. It even appeared that some of the respondents find it annoying that other professionals could include their notes and information to the system regarding a patient while others do not fill in the information as carefully as themselves and, therefore, some people even had their own lists or summaries about a patient's medications which they did not share with others.

This is an interesting finding and it might be that even if collaboration on some aspects of the work is improved, it might be hampered on other aspects.

#### *G. Collective intelligence*

Even if the interviewees had some problems expressing how the usage of the EPR affects their collective intelligence, there seems to be some ways in which collective intelligence is improved. Firstly, the current EPR was perceived as a useful tool to survive the everyday work in the primary care, especially when comparing with the old paper-based system. Secondly, it also seemed to improve all of the knowledge creation sub processes of the 7C model. Thus, according to

the model, it should, over time, increase the collective intelligence of the working community as well.

One interviewee gave an example of how collective intelligence was improved in his opinion: *"I have avoided many mistakes because the system informed me about a possible drug-interaction"*. The same interviewee continued: *"You don't always remember them, even though I should check them of course, and it would have been my fault. So it is a great relief that the system has stopped me from making such mistakes"*. On the other hand the same interviewee noted that many times the system informs about possible interaction effects with an old prescription and a new one, even if the old prescription is not in use anymore. Even so, the physicians perceived the system useful for their work.

## VI DISCUSSION

Based on the 7C model the current EPR for the management of medication information does not provide much support for organizational knowledge creation. The connectivity of the system was regarded mostly sufficient although there are some cases where a better connectivity would have benefited, such as in the case of patients visiting private healthcare units. The nationwide archive for electronic prescriptions that is under piloting in Finland could partly solve this problem. However, including only the prescriptions, without the possibility to include own remarks and recommendations would not provide proper support for knowledge creation.

Concurrency was not seen as a big problem in the primary healthcare. The respondents felt that they were sufficiently connected with the system. Based on the interviews, there is no need for mobile access to the medication information and this did not appear to disturb the knowledge creation in this research context.

Comprehension was supported to a certain extent. For instance, interaction databases and basic level reports were considered to be a valuable tool for creating knowledge. Communication was enabled by the EPR with the pop-ups and remarks that could be included in the basic level reports. The pop-ups were, however, not specific enough. For instance, if the professional is not interested in the medication information of a patient, a pop-up containing information about drug allergy should not appear to his/her window.

Conceptualization was found to be the weakest link in the current EPR system for organizational knowledge creation. The concept of "prescription" is very strong, perhaps even too strong resulting in the weak development of other concepts. A more specific common understanding about the concept of medication information and where it should be stored should be built in the system. Mainly because of the lack of conceptualization the system did not provide tools for true collaboration, and the creation of organizational knowledge.

It should be kept in mind, however, that although there are inevitable positive, intended consequences of knowledge management, there are also unintended, negative ones [11]. For instance, some of the respondents were concerned about their responsibility if the system would improve or it would

be integrated with other yet unknown systems. The physicians are responsible to check all available information about a patient before the treatment and if more and more information became available the amount of work would increase accordingly.

## VII CONCLUSION

This paper presented a field study on management on medication knowledge in six Finnish primary health care centers. The findings indicate that the current EPR is a useful tool to survive the everyday work in the primary care, especially compared with the old paper-based system. However, the utilization of the 7C model revealed that there are still many improvements needed before the current EPR can be said to truly support the creation of organizational knowledge. The biggest problem with the current EPR is the lack of means for supporting conceptualization.

A limitation for the study is the number of interviewees. In the future a deeper understanding of knowledge management processes in the health care sector is needed. It would also be interesting to study the differences between physicians and nurses in their need for medication knowledge.

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