INNOVATIVE HEALTH CARE CHANNELS
Towards Declarative Electronic Decision Support Systems Focusing on Patient Security

Kerstin Ådahl, Jenny Lundberg and Rune Gustavsson
Department of Interaction and Systems Design, Blekinge Institute of Technology, 37225, Ronneby, Sweden

Keywords: Semantics, Health-care support systems, Info sense, Rule-based models, Meta-information.

Abstract: The main contribution in this paper is a structured approach supporting validated quality of information sharing in Health Care settings. Protocols, at different system levels, are used as a method to design and implement intelligible information sharing structures. Our approach can preferably be seen as a context dependant information modelling framework that could be implemented using, e.g., web 2.0 techniques in a professional context. The main challenge is how to trustworthy convey and analyze the huge amounts of information available in Health Care contexts. Our innovative information health channel concept provides an approach to analyze and structure information as well as a contextual support towards increasing patient security.

1 INTRODUCTION

Health Care must be adequate, safe, secure, and efficient. Deficiencies in information transferring and sharing activities, verbal as well as written, might jeopardize patient security and impair the quality of care. Quality of information sharing is important, not least in domiciliary care, where delegations of tasks often are necessary.

The following Figure 1 captures some main challenges to be addressed in order to ensure patient security in future distributed health care.

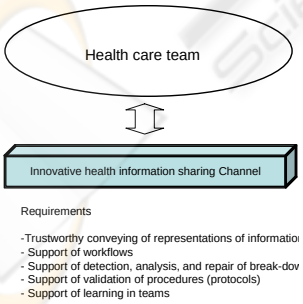

Figure 1: Challenges and requirements of Innovative Health sharing channels.

In the figure we have denoted the information sharing media as *Innovative Health Care Channel (IHCC).* The main purpose of the IHCC is to enable *empowerment* of professionals or patients to ensure increased patient security. Empowerment of patients might include insights in how to change behaviour to stay healthy or to support trustworthy rehabilitation measures. Empowerment in healthcare teams will increase quality of healthcare teams by, e.g., supporting learning and debriefing of cases.

From Figure 1 we note that the first challenge of building and maintaining IHCC concerns trustworthy conveying of *representations of information* by the channel. To that end we have to address information and information sharing in contexts, i.e., *interpretation* of representation by *teams* of human agents (Section 2.1). The second challenge focus on support of workflows or *transactions between situations*. The third challenge focus on support of *detection, analysis, and repair of breakdowns*. The forth challenge focus on support of *validation* of procedures (protocols) and work practises. The fifth challenge focus on *learning* in teams. Obviously the last three challenges are instrumental in improving *patient security* but they are critically dependant on a proper understanding and solutions of the first two challenges.

In Sweden, it is a duty to report incidents that are, potentially or directly, risks for patients safety (*Lex Maria*). However, Ödegård (2006) proves in a study that local, as well as national, reporting systems result in insufficient information about risks

Ådahl K., Lundberg J. and Gustavsson R. (2009).
INNOVATIVE HEALTH CARE CHANNELS - Towards Declarative Electronic Decision Support Systems Focusing on Patient Security.
In *Proceedings of the 11th International Conference on Enterprise Information Systems - Information Systems Analysis and Specification*, pages 423-426
DOI: 10.5220/0002156004230426

in an activity. Accordingly, complementary methods and additional instruments for the existing reporting systems are necessary in order to offer secure and safe domiciliary care: both for care recipients and care providers.

Personnel from the domiciliary care, working close to the individual care recipient, is an especially exposed party of health care since they in practise work without satisfying supporting- and security systems. An important function of a supporting system is to minimize undesirable variations of the quality of care (NICE 2007) with the aim of facilitating and securing care.

Foundations for a decision support system might be common directions, quality registers, decision bases like national guiding principles, nursing programs, routines, PM or constitutions. If a supporting system, aiming at supporting health care professionals, should contribute to and develop evidence based care, it must first of all be grounded in systematically collected, inspected and compound knowledge. Regarding this requirement, there are large deficiencies in available supporting systems of today. To find a solution to this problem, we are aiming at analyzing and developing rule based semantic context dependent prototypes for development and assessment of *Declarative Electronic Decision Support Systems* (DDSS) that are in fact instances of IHCC of Figure 1.

DDSS is an example of Professional Empowerment, a complementary direction related to the worldwide movement of Patient Empowerment. This paper describes our planning work with such an innovative Health Care Channel.

The remaining part of the paper is organized as follows. In Section 2 the concept of IHCC and the nature of information are discussed in some detail. Section 3 is focusing on basic requirements of DDSS and some clarifications of the requirements and challenges stated in Figure 1. Section 4 concludes this paper and gives some pointer to the future. Section 5 gives some references.

2 INNOVATIVE HEALTH CARE CHANNELS

Quality of Health Care is grounded in quality and trustworthiness of information and information flow. Break downs or misses in information flow causes multiple incidents and accidents every year worldwide. A conservative estimate for the industrialized world is that between 6-10% of all patients suffer from care related injuries, sometimes causing deaths. In Sweden, frequent Lex Maria Cases and reports to the HSAN (Medical Responsibility Board) indicate extended deficiencies of information flow, information interpretation or other information related faults in care. The National Board of Health and Welfare concludes, in a set of reports regarding Patient Security (*Social-styrelsen* 2008) that insufficient communication and information breakdowns are most frequent regarding causes for injuries in Health Care.

It is quite evident that there is a lack of robustness in how health related information is handled. Our suggestion is to provide a framework for an Innovative Health Care Channel (Figure 1), supporting trustworthy communication. By such a channel, systematically collected, inspected and compound information is available for use in Health Care situations. In the next section (2.1) we will clarify how our perspective on *Information* as a concept has influenced our proposal.

2.1 A Model of Innovative Health Care Channels

Situation Theory, originally presented by Barwise & Perry (1983) and elaborated by Keith Devlin (1991, 2001), constitutes a foundation for our approach. Situation Theory addresses the contexts of information to support automatization of information flow possible taking into account its *meaning*. Situation Theory clarifies the important distinction between information and representation. Information is *representation* of information, interpreted by a human agent and appropriate context.

Representations of information are interpreted by human, or machines, following appropriate procedures for encoding and decoding. Procedures can, and often is, built on experiences and learning over time. This is valid not at least for medical information that is quite complicated to understand, given a representation (texts), and requires a context to be fully intelligible and used by a human agent or a team.

Patient and Professional Empowerment are both focusing on providing necessary context to enable proper information extraction out of its representations at hand (being text, video, film, recordings, and so on). Patient Empowerment, defined as”the increasing ability of patients to actively understand, participate in and influence their health status” (Degoulet et al in Nelson & Ball 2004), is pointing at the importance of co-operation in health care; between patients and professionals.

On the other hand, Professional Empowerment is highly topical. The goal must be to match the meaning of information between the sender and the receiver but as every interpretation differs from the others (Devlin 2001), it is not conceivable to attain exact understanding, but as close as possible (Ådahl 2007).

Considering the second challenge of Figure 1, we focus on support of workflows or *transactions between situations*. Information occurs in a context (situations) and should be interpreted dependent on each specific situation, connected to meta-level *types of situations*, to support information transactions. However, it is important to exhaustively identify workflow in health care in order to build information channels for co-operation and secure information exchange (Lundberg 2007). The third challenge of Figure 1 is support of *detection, analysis, and repair of breakdowns*. To avoid breakdowns in the transactions between situations and strengthen patient security, robust channels supporting information exchange is essential.

3 DECLARATIVE ELECTRONIC DECISION SUPPORT SYSTEMS (DDSS)

Rule based systems are a useful model for implementation of knowledge based systems (KBS) and also support knowledge management. However, the proper translation from the high-level, situation type workflow support design of previous section is still not clear, since we are in fact abstracting away the semantic context into a syntactic context (Lundberg-Gustavsson, 2009).

The logical conclusions drawn from the known rules cannot capture the complete situation. However, a *shared awareness* of the intended context by the users, e.g., health care professionals, supported by system implementation guidelines, as well as complementary documentation such as active documents and active databases, expressed using suitable ontologies is a starting point for designing and implementing a IHCC (Figure 2).

Furthermore, the middle box in Figure 2, referring to *Services*, *structured information* and *meta-information*, focusing on those aspects should be a realistic strategy towards enabling more robust transactions between situations. We consider the possibilities to use *a rule based approach* for the IHCC in order to develop a DDSS.

Fundamentally, this information is validated by

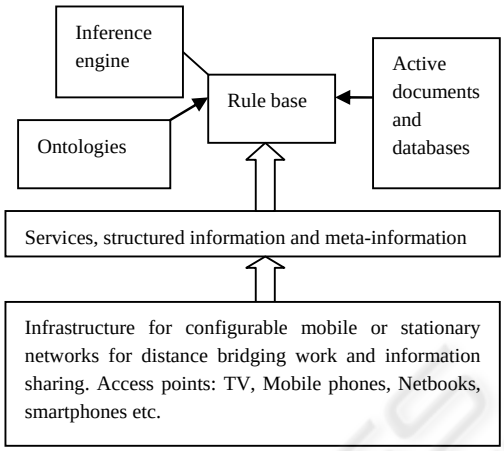

Figure 2: Architecture for Innovative Health Care Channels.

highlighting the intentions behind the data flowing (representations) and this must be executed in relation to context. Medical information is extremely vital and mistakes by using invalidated and not quality secured information from unreliable sources might be lethal. Assigning an administrative person as information analyst could be very risky and would mirror a lack of understanding of the importance that information analysis play in a medical profession. However using only the most medical competent persons in this position could create bottlenecks. Having addressed Challenges 1 and 2 of Figure 1, we now return to Challenges 3, 4 and 5 of the same figure.

The third challenge is a focus on support of *detection, analysis, and repair of breakdowns*. The DDSS should support health care professionals in work flow, preventing information breakdowns from happen. Confirmation devices such as acknowledgement, continued attention etc. can be used as a starting point to consider further similar tools appropriate in Health Care context.

The forth challenge focus on support of *validation* of procedures (protocols). This challenge concerns the predefined procedures of how to perform a certain health activity. The activity performed with the use of computer support (rule based) is to be validated according to the logic in the protocols.

The fifth challenge focus on *learning* in teams. For example, the web 2.0 solution concerns team members exchanging opinions about a certain report, drug, treatment or a certain activity performed.

Accordingly to the analysis above, a suitable architecture for IHCC such as DDSS is presented in Figure 3. The infrastructure for configurable mobile

or stationary networks enables services with structured information and meta-information, to be accessed by human agents. The rule base with connected inference engine constitutes the core for the declarative reasoning. *Ontologies* connected is a vital part in the team learning, with reference to the fifth challenge, since the different roles have different corresponding terminology, definitions as well as perspective upon the same issue.

To implement semantics (i.e. meaning) in the system, information about information is needed as a "pointer" to situations. In this matter, meta-information needs to be considered, to transform data (uninterpreted information) into context dependent information, to be interpreted by human minds. One possible way to make a rule-based system situation dependant is to implement possible situations, thus following the spirit of Lenats Cyc project (Lenat, Guha, 1990). Restricting the focus area and consider different perspectives and situations and validate them, we can approach a suitable solution. Adding data from mobile devices used close to the situation and open up for informal communication possibilities between team members is a possible way to consider. Furthermore, we also consider the accessibility perspective with situation and domain dependant search structures (Antoniou and Harmelen, 2004).

4 CONCLUSIONS

In this paper we have presented an approach towards IHCC. We state that information in health care must be viewed as situation dependent and that the representations at hand for the teams of users have to be augmented by common ground semantics to enable the intended Professional of Patient Empowerment. Mistakes concerning patient security are frequently reported to HSAN (Medical Responsibility Board) in Sweden every year and, to a large extent, many depend on information breakdowns. Accordingly, we have identified five Challenges to meet the requirements of IHCC (Figure 1). A rule based solution, DDSS, to enable development of prototypes for selected scenarios are the present focus for further investigations.

REFERENCES

Antoniou, G., and van Harmelen, F., 2004, *A semantic Web Primer*. The MIT Press

Barwise J, and Perry S, 1983. *Situations and Attitudes*, Cambridge, MA: MIT Press.

Degoulet P, Fieschi M, Jaulent M-C, Ménard J, 2004. Patient Empowerment, Cybermedicine, and Citizen Education in Nelson R, Ball M J. 2004. *Consumer Informatics – Applications and Strategies in Cyber Health Care* Health Informatics Series Springer-Verlag, New York, Inc

Devlin Keith, 2001. *InfoSense – Turning Information into Knowledge*, W.H. Freeman and Company, New York

Devlin, Keith, 1991, *Logic and Information.* Cambridge University Press. ISBN 0521499712

Douglas Lenat and R. V. Guha. 1990. *Building Large Knowledge-Based Systems: Representation and Inference in the Cyc Project*. Addison-Wesley. ISBN 0-201-51752-3

Lundberg, Jenny, 2007 *Principles of workflow support in life critical situations*, Blekinge Institute of Technology, 2007:02. p. ISBN/ISRN:978-91-7295-105-1

Lundberg, Jenny and Gustavsson, Rune (2009): *Robust approach towards context dependant information sharing in distributed environments.* In Proceedings of ICEIS 2009.

NICE, 2007. *A Step-By-Step guide to developing Protocols*. NICE National Institute for Clinical Excellence. (Link Available 2008-12-08)

http://www.nodelaysachiever.nhs.uk/NR/rdonlyres/E6182916-60F3-4DFA-9E5F-73606513D8BA/0/RG0013StepbyStepguidetoDevelopingProtocols.pdf

Socialstyrelsen, 2008. *Tema: Patientsäkerhet. Nr 2. Kommunikation i Vården*, Artikelnummer 2008-109-9 (Available 2009-01-07: http://www.socialstyrelsen.se/Publicerat/2008/10011/2008-109-9.htm)

Van Harmelen Antoniou G. F., 2004 *A semantic web primer*, The MIT Press.

Ådahl, Kerstin, 2007. *Transparency of Critical Information for Patient Empowerment in eHealth* Blekinge Institute of Technology, Licentiate Dissertation Series No. 2007:03

Ödegård, S., 2006. *Säker Vård. Patientskador, Rapportering och Prevention*, (Avhandling) NHV Nordiska Högskolan för Folkhälsovetenskap. Göteborg. Rapport 2006:1